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Index to Advertisers and Classified Index Following Reading Matter.

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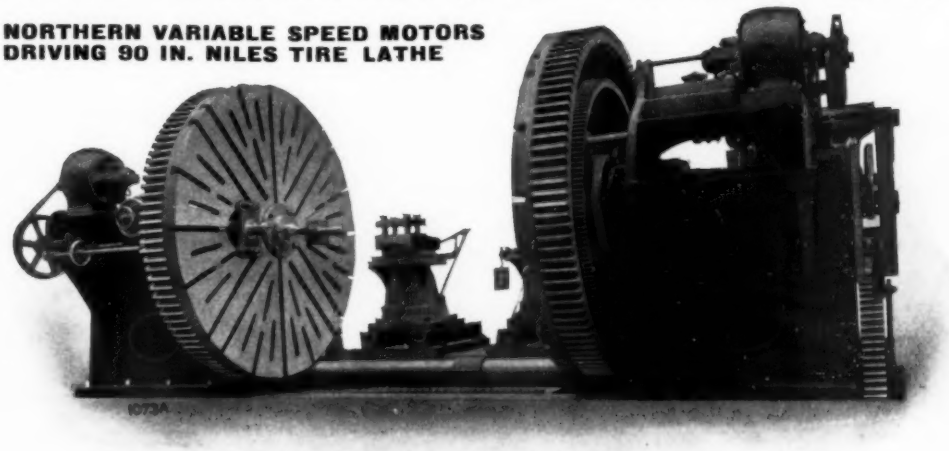

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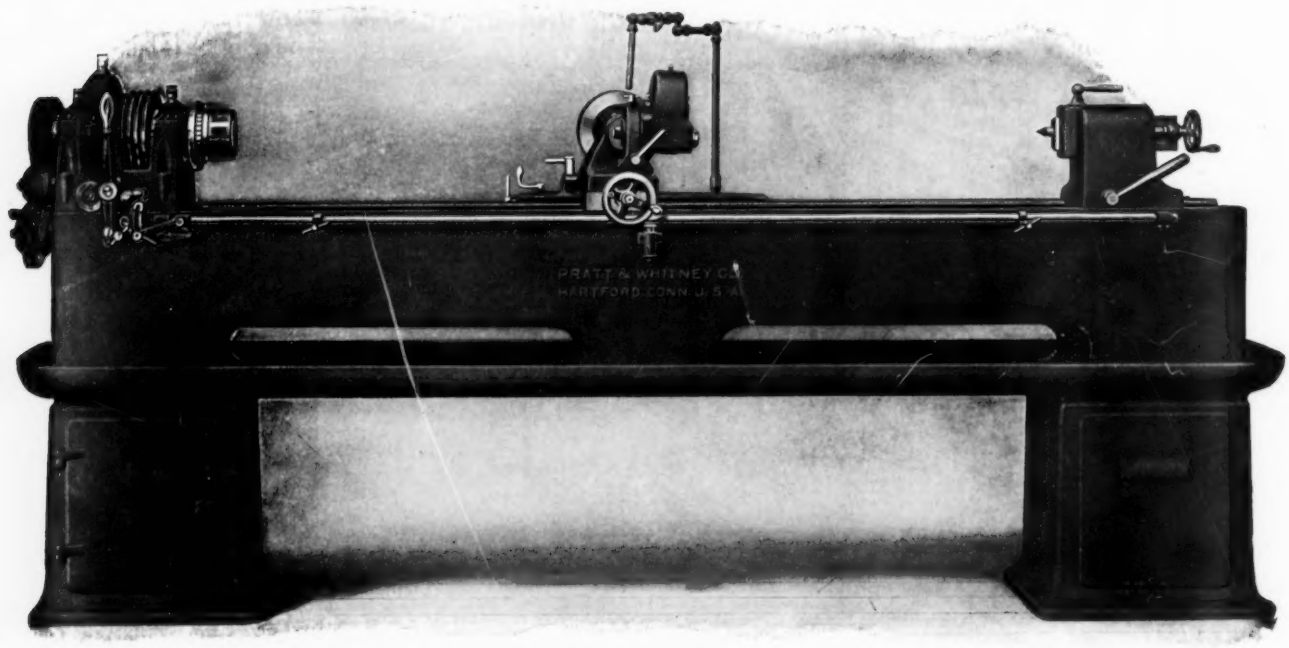

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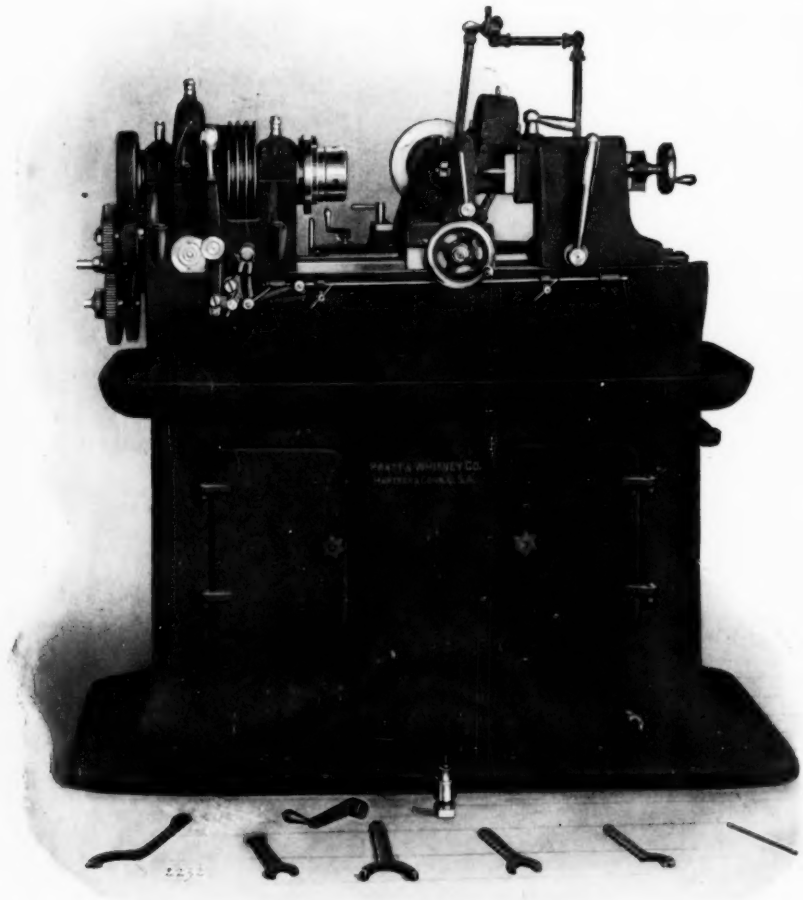

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Gages for Briggs Standard Pipe Threads and for Standard Oil Well Casing.

BY F. A. STANLEY.

In October, 1886, at a meeting held in Pittsburg, the Manufacturers of Wrought Iron Pipe and Boiler Tubes formally adopted the standard for pipe and pipe threads devised by the late Robert Briggs in 1862 and already quite extensively used at the time of the official action at the above meeting.* The Pratt & Whitney Company made a set of reference gages to this standard for all sizes of pipe from

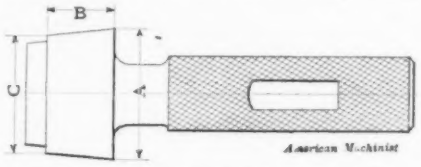


FIG. 1. BRIGGS REFERENCE PLUG BEFORE THREADING.

⅛- to 6-inch and from these as final reference standards were enabled to make accurate working gages for pipe manufacturers and users throughout the country. This first set of gages was subject to no wear whatsoever, and both plugs and rings were of unhardened steel. They remained the standards to which all the shop gages made by this concern were referred until 1903.

Two years ago the company decided to make a new set of Briggs reference gages, thinking, altho the workmanship on the original set was known to be pretty near perfection, that it might be possible, with the greater refinements of modern tool practise, to secure a still finer degree of accuracy than that attained in this first set. It is interesting to note in this connection that upon the completion of the new gages and the thorough testing of the old the latter were found to have been made with such precision that the only error detectable (and that was one so insignificant as to be negligible) was in the case of the 3½-inch plug which entered the corresponding ring a very small part of a turn too far, thus proving to be undersize, tho by a practically inappreciable amount.

MAKING THE MASTER REFERENCE GAGES.

In making the new gages (which, like the old ones, are unhardened) the plugs were made first and the rings then threaded, to allow the plugs to enter properly. In turning the plug, after the taper bar had been carefully adjusted and a long piece turned to test the correctness of the taper (¾ inch per foot) the plug body was turned off as in Fig. 1 until the required diameter was obtained at the large end. This diameter, as first turned and as represented, does not correspond to the outside diameter of the pipe, but is somewhat larger; the cone when faced off to length being equal to the length of the perfectly threaded or taper portion of the pipe end plus the two shallower threads which immediately follow the perfect threads and which are themselves perfect at the bottom but flat on top, due to their running well up toward the straight part of the pipe, as indicated in the enlarged section in Fig. 2. As the length of the tapered or perfectly threaded portion of the Briggs standard pipe end varies with the diameter as in the formula given in the sketch, where D equals the actual outside diameter of the pipe and n the number of threads per inch, the length or thickness of the gages must vary accordingly; the two threads shown with imperfect tops are of course constant in all diameters, as are also the four imperfect threads beyond, which represent merely the bell-mouth in the die to allow it to lead on to the work.

With the large end of the gage A, Fig. 1, brought to the computed diameter and the taper and length B correct, the small end C of the gage proper necessarily had to come right—that is, to the same diameter as the end of the pipe. The extension or hub at the end was then turned down to the same taper as the gage body until at the sharp corner where it joined the body it was of the same diameter as the bottom of the threads at the pipe end. In other words, this tapered hub might be considered the end of a truncated cone upon which the threads were to be wound.

With a 60-degree thread tool set square to the work axis the thread was next roughed down; then a finishing thread tool

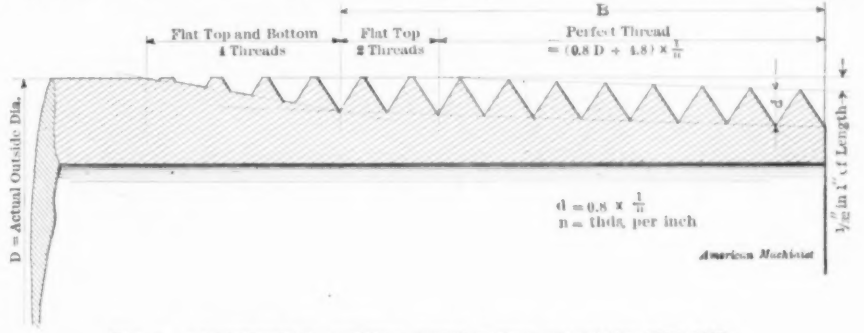


FIG. 2. LONGITUDINAL SECTION THRU BRIGGS STANDARD PIPE END.

as accurate as it was possible to make it and set dead square with the axis of the gage, was used to cut the thread down until the tool point was just in contact with the protruding end representing the thread bottom, thus showing that the proper depth had been reached. The back or large end of the gage was then turned off straight to the outside diameter of the pipe, as called for in the Briggs system, this operation flattening off the tops of the two threads and the plug body then corresponding exactly to that portion of the pipe end indicated at B, Fig. 2, and which is utilized in making the connection with the fitting; the two flat threads on the gage representing the two imperfect threads on the pipe which allow a little leeway in making up the joint.

Such, briefly, was the method followed in making the threaded ends of the plugs. The rings, left a little long to begin with, were, as previously noted, simply bored to size and taper, threaded to receive their plugs and then faced at each side to come exactly flush with the plug body.

DEPTH OF PIPE GAGE THREADS.

Now a word as to the depth of thread in plugs and rings: In the Briggs system the thread called for is slightly rounded at top and bottom, and in actual depth is equal to four-fifths of the pitch. For the sake of clearance the Pratt & Whitney gage threads are formed with a sharp root; and the top of the thread is very slightly flatted, the amount flatted off corresponding to that rounded off in the Briggs formula. The sharp "V" bottom obviously gives the thread a little greater depth, but leaves the diameter, if measured at the all-important point—that is, in the thread angle and at some known distance from the end—the same as if the thread were rounded at top and root.

Taking, say, the 2½-inch plug with 8 threads per inch, the thread, if formed with round top and bottom, would have a depth equal to four-fifths of the lead, or $.8 \times 0.125'' = 0.100''$; this is 0.00825″ less than the depth of a sharp 60-degree thread of the same pitch, which, as we all know, is equal to $.866 \times 0.125'' = 0.10825''$. The thread on the above gages, sharp at the bottom and flat on top, obviously has a depth equal to that of the rounded thread plus one-half of the difference between that thread and the regular sharp "V." In the case under consideration the depth is then 0.100 + 0.0041, or 0.1041 inch; the amount flatted off being 0.0041, and the width of flat consequently about 0.0048 inch.

GAGE SETS FOR PIPE AND FITTINGS.

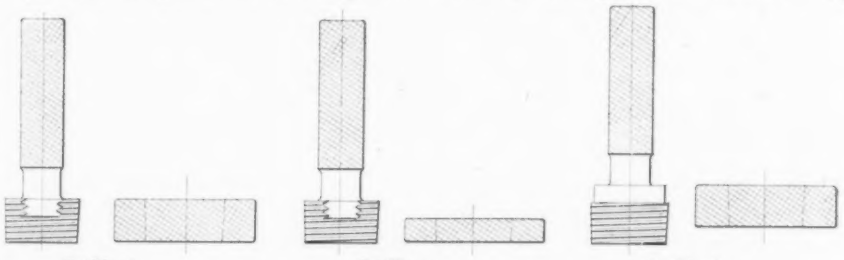
Of the gages manufactured by this company for makers and users of pipe and fittings there are three distinct sets for each size of pipe, and these are illustrated in Fig. 3. Set No. 1 consists of a ring and plug conforming in all dimensions to the

*At a New York meeting of the same association held in May, 1899, a change in the 9 inch size was adopted, the outside diameter, 9.688 inches, recommended by Briggs, being reduced to 9.625 inches.

Briggs standard, and is known as the standard reference set. The plug screws into the ring with faces flush—as indicated by the position of the two gages. The flat milled on the plug shows the depth to which the latter should enter the fitting to allow for screwing up with tongs to make a steam-tight joint; the ring of course screws on to the pipe flush with the end.

Set No. 2—the working allowance set—consists of the plug already described and a ring whose thickness is equal to the standard ring less the allowance for screwing up the joint. As the plug and ring threads are of the same diameter at the small end, the bottom surfaces come flush when the two members are screwed together. It will be noted that, as the plug enters the fitting only to the bottom of the flat at the side, and the ring screws on to the pipe only far enough to bring the outer face flush with the pipe end, there are a few threads on, or in, the work beyond the reach of the gages; hence with this type of gage a reasonable amount of wear may be permitted at the end of the tap or the mouth of the die without causing the rejection of the work.

The plug and ring in set No. 3 are inspection allowance gages, the ring being the same in all particulars as the standard gage in set No. 1, while the plug is longer than Nos. 1 and 2 by an amount equal to the allowance for screwing up for a tight joint, this extra length being represented by the cylindrical portion at the rear of the thread cone. When the gages are screwed together the back of the cylindrical section comes flush with the ring face and the threaded end of the plug projects thru the ring, as indicated, a distance equal to the length of the cylinder, or the screwing-up allowance. This plug will enter a perfect fitting until the back of the threaded section is flush with the end of the fitting, thus testing the full depth of the tapped thread in the same way that the standard ring gage covers the thread on the pipe end, and at the same time showing that the fitting is tapped to right diameter to allow the joint to screw up properly.



Briggs Standard Gages. Working Allowance Gages. Inspection Allowance Gages.

FIG. 3. BRIGGS PIPE THREAD GAGES.

The rings in these sets are all forged from steel disks, hence are weldless; and both plugs and rings are of machine steel of about 20 points carbon, so as to case-harden deeply, as all sizes under 3½-inch (except when made for reference purposes only) are regularly hardened—but not ground in the thread angle—and the larger sizes are also hardened when so required.

LARGE PIPE THREAD GAGES.

In connection with the machining and hardening of some of the very large gages some remarkable work is being done at the Pratt & Whitney shops. For not only are hardened Briggs plugs and rings made for pipe as large as 12-inch, but for oil-well casing, which has a standard taper thread of ⅜ inch per foot, the gages are made to cover sizes up to 16-inch. Yet in these big threaded and hardened plugs and rings a high degree of accuracy is attained as in the smaller and more easily manipulated sizes.

Not only is it remarkable that hardened pipe thread gages can be accurately made to the diameters given, but it is also a very striking circumstance that there should be a demand by any pipe fittings manufacturer for hardened, precision gages for large work of this character; and the fact that there is such a demand shows that certain of the more important establishments engaged in this line of work recognize the numerous advantages to be derived from the ability to produce the large sizes of fittings with the same assurance of proper fits as is secured in the small sizes, and that the expense involved in adopting the necessary test tools is fully justified by the results obtained thru the aid of these accurate appliances.

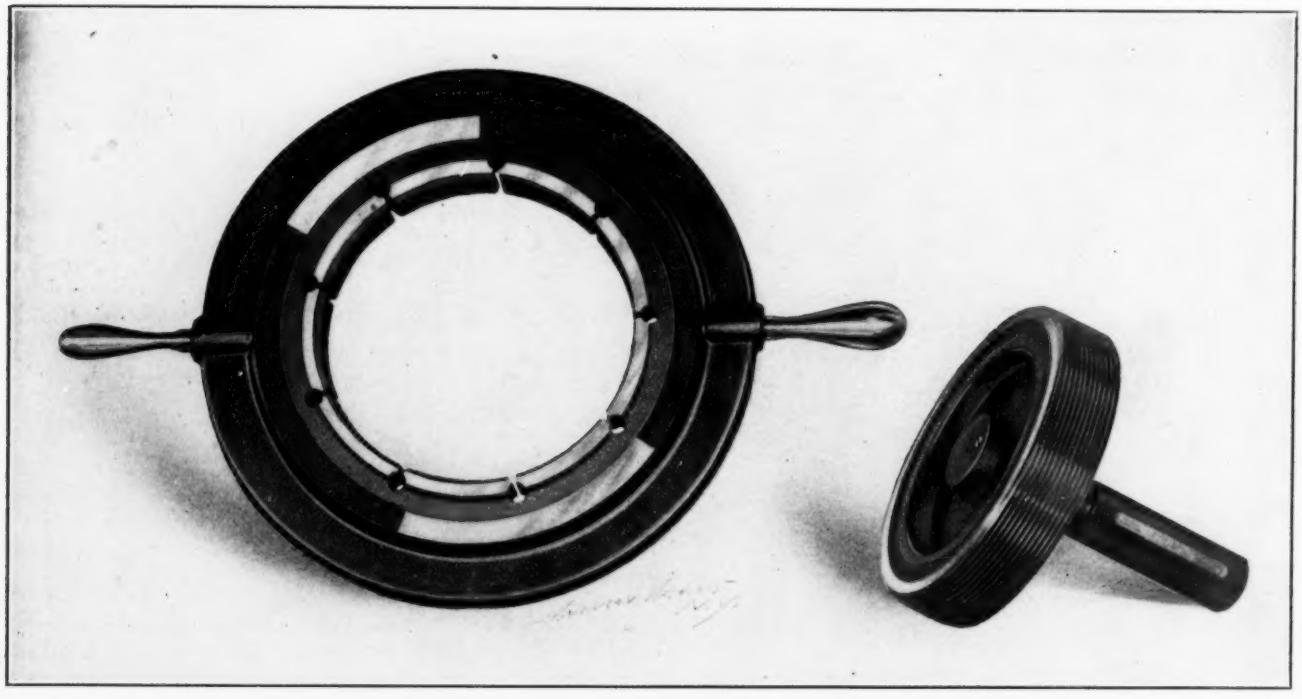


FIG. 4. 7-INCH RING AND PLUG—BRIGGS STANDARD.

THE DIFFERENT GAGE DESIGNS.

In the complete line of pipe-thread gages from ⅛ inch up there are three methods of construction followed. All the

smaller sizes—that is, up to and including the 6-inch—are made from the solid steel; but this construction is obviously not feasible for the larger sizes. From 7- to 9-inch inclusive the ring gages are forged out from steel disks and pressed into stiff, gray-iron rings; the plugs are also formed of forged rings pressed on to tapered gray-iron centers or spiders, and both plug and ring gages are provided with suitable handles. From 10-inch up all plugs and rings, whether Briggs or oil-well casing standard, are built-up gages consisting of threaded steel sections secured to gray-iron bodies.

A pair of 7-inch Briggs gages of the threaded-steel-ring and gray-iron-body construction just noted are illustrated in Figs. 4 and 5, the one view showing plug and ring gage separated, the other the plug screwed flush into the ring. The threaded rings forming the working portions of these gages are of comparatively light section and the ring gage is drilled thru and grooved transversely at frequent intervals; after they are threaded in position they may be removed from their holders and case-hardened, and then pressed back again to their conical seats with the certainty that the stiff gray-iron section will overcome any slight deformation in the ring contour occurring during the hardening process, and thus bring the gages to their true original form.

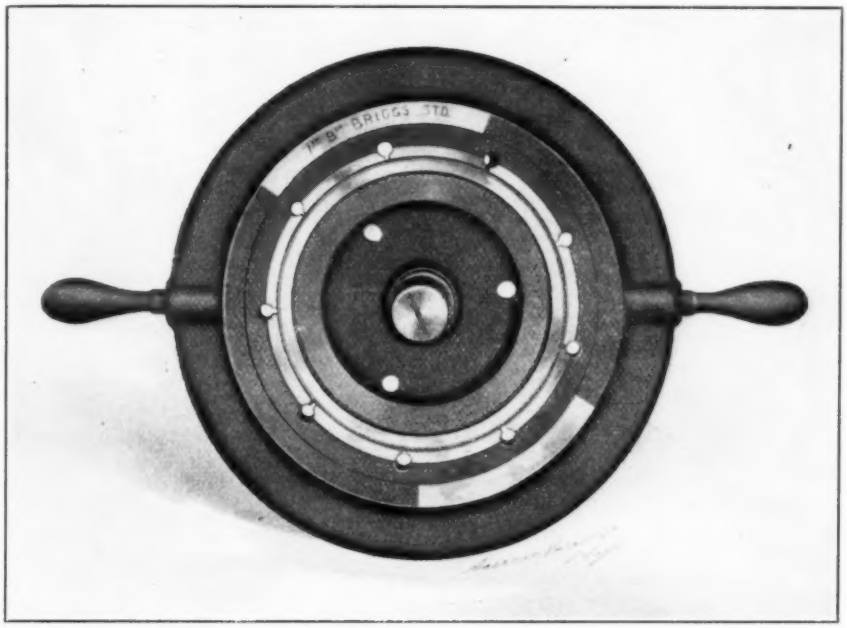


FIG. 5. 7-INCH RING AND PLUG—BRIGGS STANDARD.

The gages in Fig. 6 are for 14½-inch oil-well casing, cut ⅝-inch taper per foot and 11½ threads per inch. The segmental construction referred to is here clearly shown, and the details will be understood from Figs. 7 and 8, which show casing and center for a pair of Briggs 10-inch standard pipe-thread gages with a steel segment for each. As in the case of the somewhat smaller gages illustrated, the impossibility of entirely avoiding deformation during hardening has been recognized in the design of these big plugs and rings; the idea therefore is to reduce so far as possible the liability of springing under treatment, and then depend upon the heavy gray-iron shell or spider, as the case may be, to overcome what little spring there may be in the threaded steel members. By cutting the rings into short blocks or segments, as shown (there are usually eight in the larger gages), but little change occurs in any of the blocks under careful pack hardening; and as each segment is deeply slitted crosswise at two different points, any slight deforma-

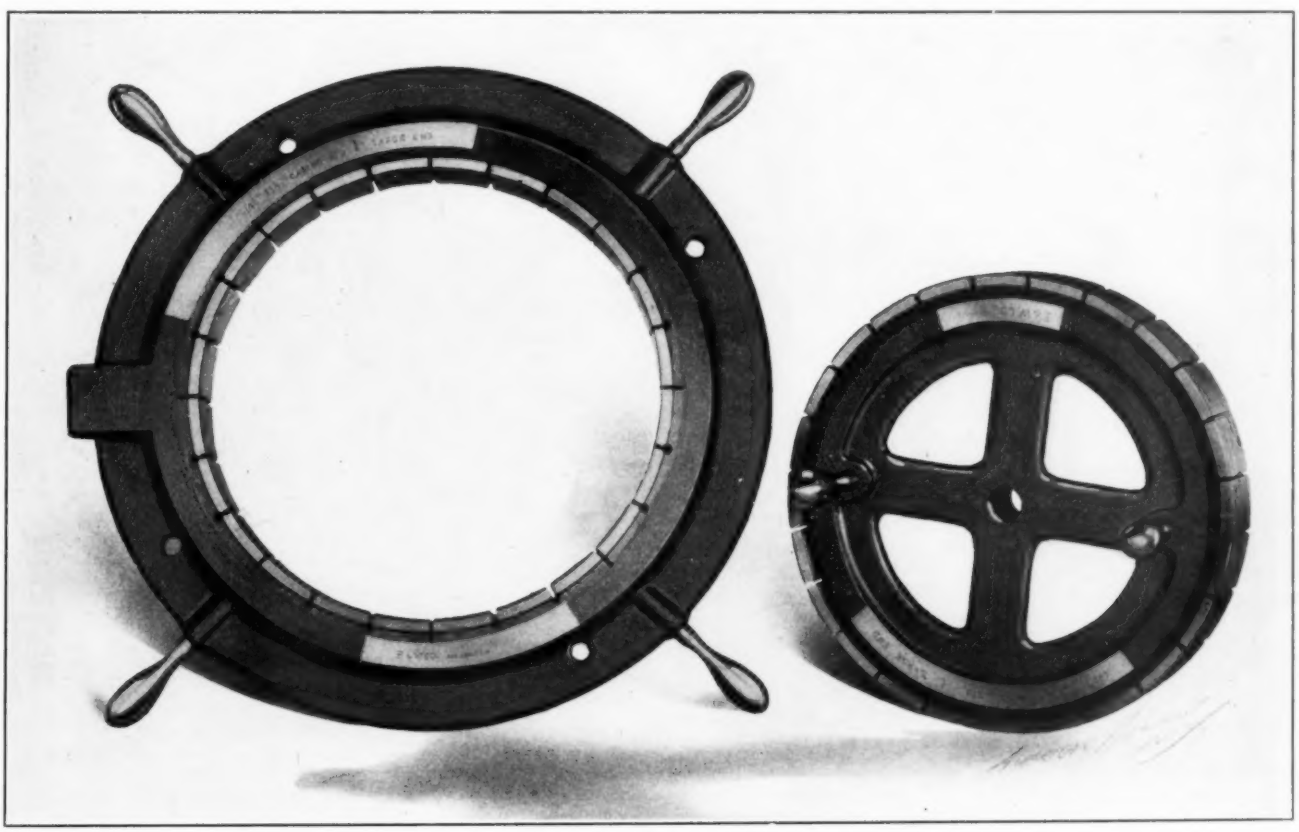


FIG. 6. 14½-INCH OIL-WELL CASING GAGES.

tion which may have taken place entirely disappears when the steel piece is drawn back by its screws to its seat in, or on, the gray-iron body. To still further minimize the danger of the work changing apput thru the steel blanks and the casting by indexing the table. Then as the tapped holes must not come thru the working surface of the segments the casting is drilled as indicated, and the screw holes in the

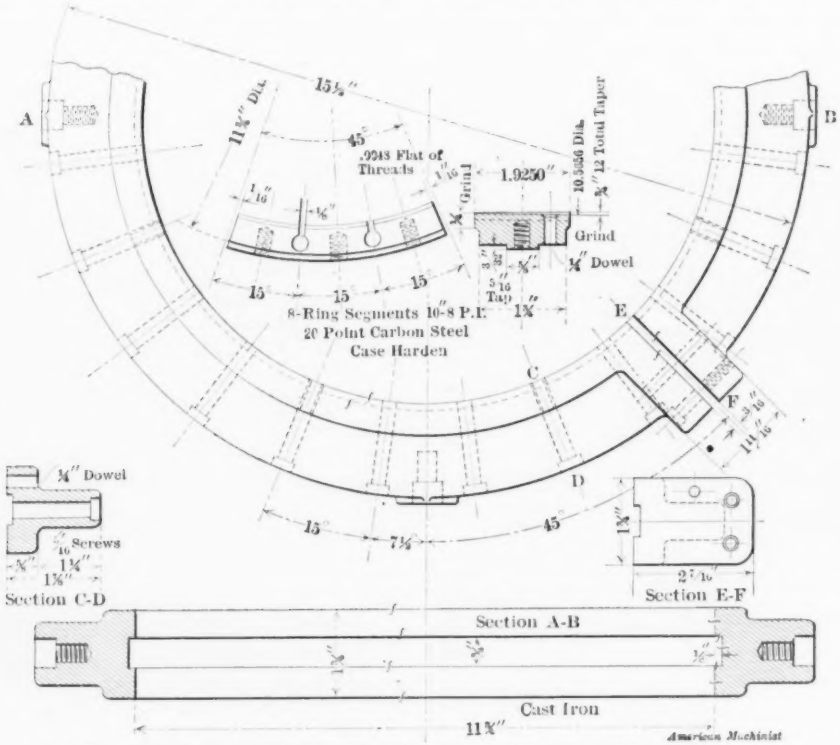


FIG. 7. CASING AND SEGMENT FOR BRIGGS 10-INCH PIPE-THREAD RING GAGE.

preciably in hardening, the weakening saw slits are not cut thru to the drilled holes, but instead a web of metal is left as a stiffener, which is cut out by a narrow emery wheel previous to the final assembling of the gage. A similar method is followed in handling the steel rings used in gages of the type shown in Figs. 4 and 5.

MAKING THE LARGE GAGES.

In machining the large built-up gages the forged rings when turned up or bored out to fit the cast casing and center are left with a ⅝-inch rib or circular tongue running straight around the ring, a groove of corresponding width being cut in the gray-iron retaining members. Before threading, then, the rings already drilled and slotted crosswise must be cut up and fitted to their castings, and for this work the horizontal boring mill in Fig. 9 is utilized, the ring being mounted on an indexing circular table, and cut into segments by means of a slitting saw carried on a special arbor. Then the steel sections—if for the ring gage—are held in the casing Fig. 7, and holes for dowels and screws put in with the work indexed by means of the circular table and with drill and reamer carried in the spindle. After fitting screws and dowels the gage is ready for the threading lathe.

In fitting plug gage segments to the iron center, which in Fig. 9 is shown drilled on the boring mill table, with two finished segments in front, the dowel pin holes are steel pieces are located from the inside and then drilled and tapped.

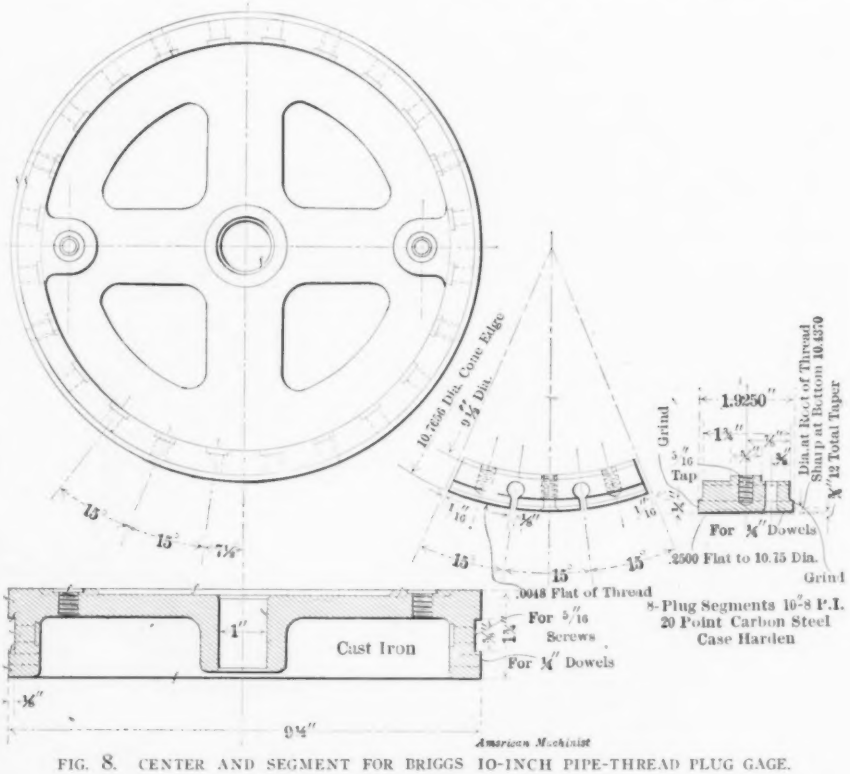


FIG. 8. CENTER AND SEGMENT FOR BRIGGS 10-INCH PIPE-THREAD PLUG GAGE.

THREADING PLUGS AND RINGS.

Fig. 10 illustrates the 24-inch lathe in which the threading operation is performed, and shows a large ring gage mounted on the face-plate and cut with a thread-miller cutter. The gage casing has four holes thru the rim which admit the screws for attaching it to the face-plate; and the four blocks and the contacting face of the gage are carefully surfaced to allow the work to be held without springing. The plug has already been finished, it being threaded first in all cases and the ring gage then threaded to fit it. The plug is correctly sized by calipering at the large end and accurately cut to depth by means of a special gage; and the ring gage, which is finished to size and taper in the bore after attaching to the face-plate, is left a little wide to admit of facing off flush with the plug after threading.

The milling cutter is of 60-degree sharp-V form, as the thread must be sharp at the root, and is mounted on a stiff spindle carried in a quill and driven from the countershaft by a 2-inch belt on a 9-inch pulley. The quill is clamped to the tool block with the axis of the spindle parallel to the lathe shears, and the taper bar gives the necessary receding movement to the cutter as the carriage is fed along by the lead screw. The lathe spindle with back gear in is driven by belting direct to the largest step on the cone from the back-gear shaft of a 14-inch lathe which stands in a row of tools immediately behind the 24-inch machine; as the lighter lathe is driven at its slowest speed, it will be seen that a very great reduction in speed is obtained for the lathe spindle, the latter in fact making only one turn in fifteen minutes.

The work is kept well lubricated and

FIG. 9. DRILLING A LARGE PLUG CENTER.

FIG. 10. THREADING A LARGE RING GAGE.

only a few cuts, usually not over two or three, are required in the gage, the settings being accurately made thru a graduated dial on the cross-feed screw, and no chances are taken with these expensive affairs by opening the feed nut at the end of the cut and returning the carriage by hand in order to save as much time as possible. Instead, the slow belt is slipped off and the lathe reversed by the regular belt, which remains idle during the cut, and the carriage is then run back with relatively little loss of time and with no risk of injuring the work thru confusion or error upon the part of the latheman.

The final pass which is made for the sole purpose of insuring a dead sharp V at the thread root is performed with a hardened steel roller which is ground to a sharp 60-degree form and mounted at the end of a shank which is secured to the tool-post after the milling apparatus is removed. The milled thread, which is already as perfect as a cutting tool can make it, is cleaned thoroughly and then the roller is fed thru just touching the bottom and bringing it up sharp throughout the length of the thread. The segments are then removed, are hardened (without affecting the lead), ground out in the saw slits and replaced, and the gage sides ground off to come flush with the plug. Substantial handles are screwed into the perifery and the size, pitch, etc., stamped on finished spots at either side.

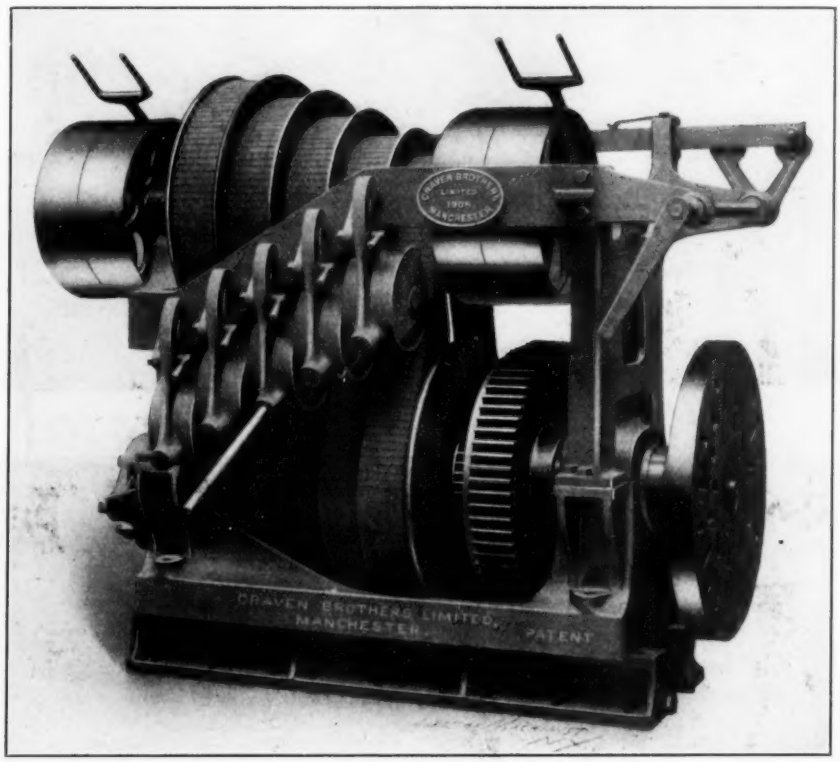
TIME SAVED BY USE OF MILLING CUTTER.

The thread-miller cutter is found equally useful on both plug and ring work, and its adoption has cut down the threading time on these gages to about half that required when the ordinary lathe tool was used. It might be expected with the milling cutter acting upon the slowly moving surface with belt and gearing for the rotary feed, that there would necessarily be more or less vibration and chatter; where this tendency has developed it has been entirely overcome by passing a weighted leather strap over the top of the face-plate, the weight putting enough friction on the plate to steady it completely.

It will be observed that the cast member of the ring gage in the lathe, as well as that shown in Fig. 6, is provided with a boss at one side which comes opposite the open joint between two of the steel segments. In the drawing, Fig. 7, this boss is split and doweled and provision made for opening or closing the ring slightly by means of opposing screws. But while it was deemed best when this layout was made to provide for a little adjustment as it was not then known how successfully the shop was going to hold these big rings to size, the adjustable feature has never been actually incorporated in the gages; for, from the first one made until this time, not one of the twenty-five or thirty constructed has required setting in or out after finishing. Consequently, future castings for ring casings will be made without provision for splitting.

High-Speed Lathe Headstock With Jockey Pulleys.

With the redesigning of lathes, consequent on the introduction of high-speed steels, very special attention has naturally been directed to driving headstocks. With the ordinary cone pulley, to change the spindle speed, it is of course necessary to move a heavy broad belt, and as this may run at a speed of 2,000 feet a minute, the operation of changing from one step of the cone to another is often difficult and even dangerous. For this and other reasons all-gear heads driven by constant-speed belts are being applied. Messrs. Craven Bros., Ltd., Vauxhall Works, Manchester, England, in their high-speed heads for driving lathes and similar purposes use no gear cones but drive by belts, believing that by this means a better mechanical efficiency is obtained. To prevent the need for changing the position of a single belt, they fix a countershaft to the headstock just above the cone pulley, and on this countershaft they have another cone. Each step of the cone pulley has its own endless belt, quite loose. The countershaft is arranged for double speed, and of course when the lathe is running all the belts are in motion. But in front of each belt is an independent swing frame fitted with a jockey pulley, which can be locked in position. By this means whichever speed is wanted for driving the lathe spindle can be applied, as shown in the illustration. The jockey pulley has a special connection with Manchester, for it was there that Dr. Hopkinson used it in the belt driving of dynamos at short centers between engine and machine. Slip is minimized, a better contact on the pulleys being obtained, especially when using the smaller diameters of the cone pulley, so that larger cuts can be taken than with the old method of drive. Again, a single belt must necessarily drive on every step of the cone, which must be proportioned to this end. But in the Craven head the diameters of the driving cone can be calculated for special work, and may give the correct cutting speed for various diameters of repetition work. Another difficulty overcome is that of high-speed countershafts fixed out of reach of proper attention and lubrication. This self-contained countershaft is within reach of the workmen and runs in extra-long adjustable ring-lubricated bearings. Moreover, this headstock makes a lathe self-contained and is well adapted for electric driving. As illustrated, a 15½-inch center headstock is shown fitted with a 5-step cone pulley, 10 inch to 28 inch diameter by 5½ inch face. With the two-speed countershaft running at 190 and 250 turns per minute, respectively, the speeds of the spindle are as follows: Single speed—722, 532, 405, 307, 250, 190, 154, 117, 89, 68; double gear—68, 50, 37.2, 29, 23.3, 18, 14.5, 11, 8.4, 6.3. The speeds are suitable for turning a very large range of diameters at 60 feet per minute, say, if needed, from ⅜ inch to 36 inch diameter. The headstock is shown with the wheel guard removed, but the gearing is completely guarded when at work.



HIGH-SPEED LATHE HEADSTOCK WITH JOCKEY PULLEYS.

Electric Drive for Large Lathes.

BY OSCAR E. PERRIGO.

The advantages of having a machine tool, particularly a large one, driven by its own individual electric motor are many, however the electric drive may be arranged. They are greater if the machine was originally designed to be so driven, and particularly with a variable-speed motor. But it sometimes happens that we are called upon to arrange an electric drive to a machine already built and perhaps in use in the shop. We may also be required to drive it with a constant-speed motor, and must therefore make proper provisions for speed changes.

Under these conditions a large lathe had to be arranged for parties who insisted that the cone pulley in the headstock should be replaced by a series of gears of varying diameters and so arranged as to engage any one of a second series of gears located on a supplementary shaft in front of them, the gears being placed at unequal intervals, the smallest somewhat greater than the width of their faces from each other. The lathe was so arranged and successfully used, yet the necessary complication of the shifting apparatus, and the difficulty of readily bringing the proper gear into engagement with its fellow by sliding the gear longitudinally rendered the device somewhat clumsy and inconvenient, and was the cause of some bad language on the part of the man who ran it.

The next occasion on which a similar problem arose the customer was not insistent upon any particular plan, only he "didn't want it like the other one." The motor to be used was of constant speed and the following device was adapted in attaching it to the lathe, as shown by the front elevation in Fig. 1, and the end elevation in Fig. 2.

The countershaft cone *A* is mounted on a shaft journaled in the brackets *B B* attached to the headstock, as shown. At the rear end of this shaft is fixed a gray-iron gear *C*. The motor *D* is supported upon a bracket *E* attached to the lathe bed and carries on the end of its shaft the steel pinion *F*. Between the pinion *F* and the gear *C*, and journaled on the bracket *G*, attached to the headstock, is a rawhide gear *H* engaging both of them. This is introduced to avoid the noise which would otherwise be caused by the fast-running pinion *F* on the motor shaft. The gear *H* is constructed with a gray-iron flange on each side, one flange having formed upon it a hub passing thru the rawhide blank and the opposite flange, and the whole firmly secured together by six flush-headed screws, the object of this construction being to furnish a good bearing on the stud upon which it runs and also to furnish proper support for the ends of the teeth.

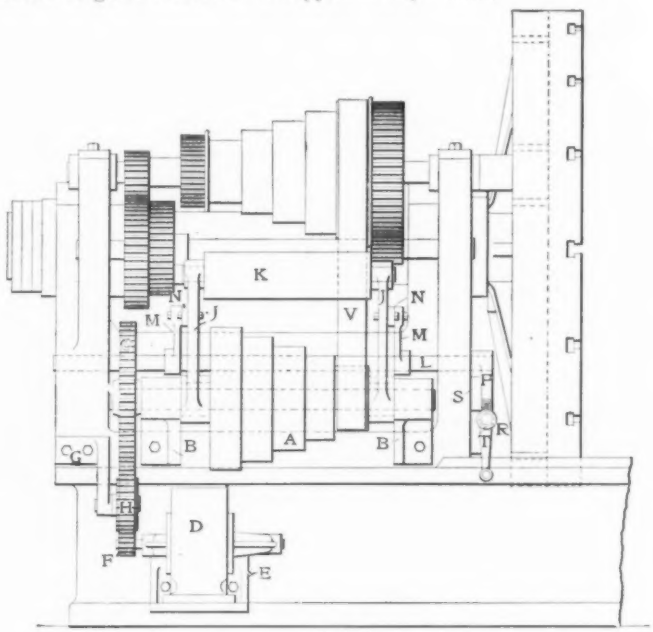


FIG. 1

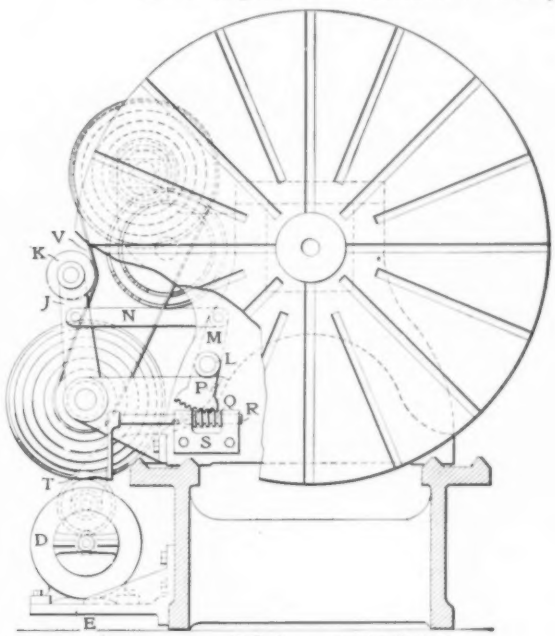


FIG. 2 American Machinist

ELECTRIC DRIVE FOR A LARGE LATHE.

Upon the bosses of the brackets *B B* are formed projecting sleeves upon which are journaled the arms *J J*, in the upper ends of which is journaled the belt-tightening roller *K*, which is composed of a piece of 5-inch extra-thick wrought iron pipe, provided with gray-iron heads thru which its shaft passes. Thru the two end portions of the headstock holes are drilled in which is journaled the rock shaft *L*, upon which are fixed the two levers *M M*, the upper ends of which are connected to the arms *J J* by the connecting rods *N N*. Upon the front end of the rock shaft *L* is fixed the worm segment *P*, which engages the worm *Q*, the shaft *R* of which is journaled in the bracket *S*, fixed to the front of the headstock, as shown in Fig. 2. Upon the outer end of the shaft *R* is fixed the crank *T* for operating the belt-tightening device.

The belt *V* is cemented instead of being laced, to facilitate its smooth running. By a backward turn of the crank *T*, the belt *V* is rendered slack enough to be changed from one step of the cone to the other, and a forward turn of the crank tightens it as much as may be necessary to drive the lathe.

In practise it was found that the operator preferred to use the crank for stopping and starting the lathe to examine and caliper his work rather than to use the electric switch or the rheostat, claiming that it was more convenient to allow the motor to continue to run and start the lathe gradually by tightening the belt slowly for that purpose, and we must admit that the operator of a machine, in his daily experience, frequently finds convenient ways to "do things" that the designer or the foreman may entirely overlook.

While the device here shown is simple, and no claim is made of anything strikingly new or original, it has succeeded admirably and given good satisfaction to the proprietors as well as to the employees of the shop where it is in use, and will be found an economical, convenient and efficient method of applying the electric drive to existing lathes.

The authorities of Stevens Institute of Technology have taken up vigorously the task of raising the additional $100,000 required to render available the $100,000 conditionally donated by Andrew Carnegie and President Alexander C. Humphreys ($50,000 each) at the recent dinner of the "Stevens" alumni. It is expected that the alumni will heartily cooperate by contributing and by awakening the interest of their friends.

Many a kit of tools—often an extensive and expensive one—does not contain a pocket or hand mirror. Why not?

Studies In Inventive Problems—VI.

Proposed by Leicester Allen and Solved by Various Readers.

Among the professors who have personally addressed me on the subject of these problems is Professor W. H. Rasche, of Virginia Polytechnic Institute, from whose letter I may be allowed to quote. He writes:

"I am following with considerable interest the solutions and your valuable comments thereon of the 'Inventive Problems' now being published in the AMERICAN MACHINIST. I am of the opinion that your work will be of great value, and I shall encourage my students to work at the problems, even if they have not the time to make and present formal solutions.

"I wish to call your attention to what seem to me to be serious objections to solutions 6 and 9, Problem I. In neither of these solutions is there any proper means provided for bringing the crosshead (instantaneously) to rest at the right angle. Without such means it would seem that the machine must fail to act unless the motion is very slow, which, I believe, is directly contrary to the conditions of the problem. You will notice that solution No. 4 is not open to this objection. In fact, if solution 6 is admissible, then clearly the guides *a b c*, *g h k* and the rod *b h* are superfluous, as the crosshead *e* could be driven just as well directly by the connecting rod *r e*."

The parts in solution No. 6, thought superfluous by Professor Rasche, are those which keep the block moving parallel to itself when near the angle of the path. In editing Mr. Strohm's solution, No. 6, it may have been my fault that the rigid attachment of the block to the rod *b h* is omitted in the description, but I certainly so understand it, and am sure this was either expressly stated or implied by Mr. Strohm. Pivoting the blocks to the rod was surely not his intention. Were these criticised parts omitted, some other means of preventing the tilting of the block in passing the corner would need to be supplied.

With reference to solution No. 9, I can assure Professor Rasche that with light parts it works nicely, as I have proved by actual construction. The block starts on the vertical branch of its path exactly as required. With heavier parts and considerable resistance it might not do so well.

SOLUTION NO. 25. FIGS. 1, 2 AND 3. A. M. SOSA, HAMILTON, OHIO.

Both the drawing and descriptive text of this solution are in excellent form, except that more reference letters in Figs. 1 and 2 would have enabled readers to follow the description with greater ease. It is evidently the work of an accomplished draftsman, and will prove a good study, whether it is considered as entirely fulfilling all the requirements of the problem or otherwise. To gain a rapid motion of the slide by this method would, however, require a rapid rotation of the screws, even if they were multiple threaded. Mr. Sosa regards the turning of the angle of the path without a slight stop as theoretically impossible at a uniform rate of speed, involving the instantaneous destruction of one momentum and the instantaneous creation of a second momentum which would require an infinite force. In this statement he is theoretically correct, but he admits that on account of some play being needed for working fits, and the ever-present elasticity of the materials used in machines, this requirement is practically possible. The requirements of all the problems are to be taken in the practical sense, unless expressly stated to be theoretical. The deflection of a moving body from a given course into another at an angle therewith

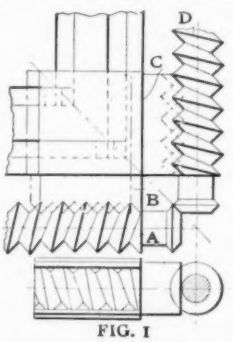


FIG. 1

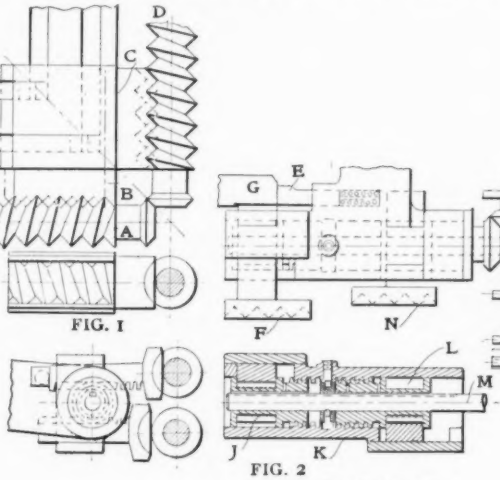


FIG. 2

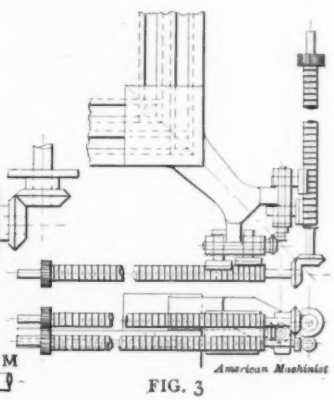


FIG. 3

PROBLEM NO. 1.

without any *sensible* stop, is practically possible. The terms used in these problems are to be understood as they would be in the drawing offices of engineers or in machine shops generally.

"The solution is designed for uniform rate of motion at all points. Fig. 1 shows a square block guided by two small square blocks fitted to a slide in two grooves or slots, as shown in Fig. 3. When the large block is on the vertex of the angle of its path it is free to slide on either side of the angle, but cannot turn around. The drive is supplied by two screws connected at right angles by bevel gears whose conical apex is on the diagonal of the angle of the path projected to the outside. The thread of these screws is of a 90-degree cross-section, both the same hand. The main block has two lateral projections with a portion of a nut cut in each (not complete half nuts), which mesh with the screws. When the block is on the corner, both nuts fit both screws. Suppose the block to be driven from left to right, and that when in the position shown by 'dot and dash' the thread of nut *C* is opposite the thread of screw *D* corner to corner. The thread of screw *D* advances at the same time that the block continues to approach it, and at the same speed. The upper sides of thread of nut *C* slide against the under sides of thread of screw *D* until both get to full mesh when the block reaches the corner. The screws continue to rotate, and nut *B* comes to a full stop on its horizontal movement when it starts upward, being displaced from mesh with screw *A* by the advance of this screw *D* at the same time and at the same speed the nut *C* is driven upward.

"Fig. 2 shows the mechanism used for reversing. There are two screws, same pitch, same hand, 90-degree thread, rotating in opposite directions. Two nuts are connected to the main block and one nut, doing the drive, gets to a full stop, and starts to be displaced from mesh with its screw. At the same time the other nut starts to approach the other screw while traveling along, keeping its threads in front of the threads of the screw, until full mesh takes place, when the first nut is out and the second nut is driving the block in its return motion. From the time the first nut gets to full stop until the second nut gets into full mesh with its screw, the main block is kept in motion. *E* forms back thrust to *F*, and the whole carriage approaches the top. When near the end of the travel, *G* starts to slide *E* from the back of nut *F* and, when *E* is all out, nut *F* stops against *G*. Here the nut starts to slide back. A rack cut in it turns pinion *J* held in line with the rack by flanges shown. This pinion has on its hub a thread whose nut, cut in sleeve *K*, forms one piece with the main block, so that, tho the nut gets to a stop, the turning of the pinion keeps the main block going by the thread on its hub. On the other end of sleeve *K* is cut another thread double the lead of the first one. In it is fitted another pinion *L*. Pinions *J* and *L* are splined and free to slide on shaft *M*. When *J* turns *L* turns, and by the combined action of its thread and

pinion, nut *N*, which also has a rack cut in it, approaches its screw moving in the opposite direction to that of the main block, and in unison with its screw, keeping the thread in ready position in front of the thread of the screw. Fig. 3 shows a combination of Fig. 1 and Fig. 2 producing the required mechanical motion. A projection of the main block, like the apron of a lathe, holds the two combinations in angular relation, the pinion shafts being connected by bevel gears."

I regret that want of space excludes an excellent and instructive exposition of a method of designing this mechanism for any assumed path, which Mr. Sosa has furnished. He closes his communication with the query: "Now, will this motion, if satisfactory, be of any practical value?" I reply that nothing but the educational value of these problems, as exercising faculties constantly employed in designing, is considered when they are proposed. A new mechanical movement is like the discovery of a new chemical compound; its useful applications remain to be discovered.

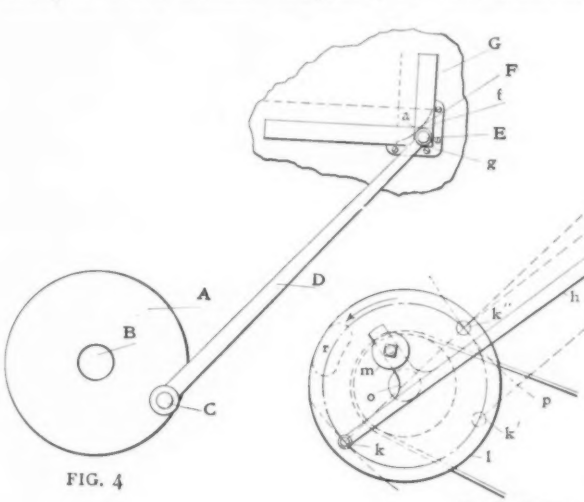


FIG. 4

FIG. 5

American Machinist

PROBLEM NO. I.

SOLUTION NO. 35, FIG. 4. MR. A. E. J., who requests suppression of his full name and address.

In this solution *A* is a crank-disk, *B* crank-shaft, *C* crank-pin, *D* connecting link, *E* pin on sliding block *F*, *G* slotted member, and *f* an additional steady-piece rigidly attached to *F* and bearing against slides *I* when *F* approaches the corner of the path, *f* and *g* being in a plane above or below plane of *F* and *G*.

This is a simple solution and would fully meet the conditions stated in the problem were it not that in operation it encroaches upon the inhibited space above the horizontal, and to the left of the vertical branch of the prescribed path. It is here produced to point out a mechanical defect, that some of the younger readers of this series might overlook, to wit, that even if the encroachment upon forbidden space indicated by dotted outlines in the drawing (which I have added to the sketch) were avoided, the angle *a* both of the sliding block and the guideway, would soon wear away and permit the objectionable tilting of the block, which, as will have appeared by this time to all who have studied the problem, is the most important thing to be avoided in designing a slide movement to describe an angular path. The constant thrust of the block, if guided as shown by A. E. J., will be, in approaching the angle *a*, against constantly diminishing surfaces, sure to wear away after very brief use.

SOLUTION NO. 26. E. T. G., ERITH, KENT, ENGLAND.

Comparing this with solution No. 16, printed March 2, 1905, it is found, in essential features, similar to that solution.

SOLUTION NO. 27, FIG. 5. LEICESTER ALLEN, BOROUGH OF BROOKLYN, NEW YORK CITY.

The sliding block *a*, a side and end elevation of which is shown at *W*, slides in ways *b* and *b'*, supposed bolted to a suitable frame or table. The terminal point of the longer branch, the point at the angle turned and the terminal point of the shorter branch of the path are respectively at *c*, *c'* and *c''*. At *d* is shown what, for want of a better name, I will term a shuttle-block or shuttle-slide. On the side presented in the figure, and at the upper margin, this shuttle-block (which is fitted to work in the vertical ways *b'* only) has a stop-bar *e*, rigidly attached. This stop-bar works down to, and rests upon, stops *f* rigidly attached to the ways, during the entire time that the block *a* moves horizontally either toward or away from the point c'. On the lower side of the shuttle-block is formed a tongue-piece *g* of tee shape, as shown at *W*, or which may be of a dovetail section if preferred. This tee-shaped tongue is made a neat working fit in a correspondingly shaped groove in the slide *a*. The side elevation at *W* shows the block *a* and the shuttle-slide brought together into relation, as when the point *c* of the slide coincides with the point *c* of the path. In operation, when the slide *a* is moved into such coincidence, it forms with the shuttle-block one long slide, the upper part of which is already engaged in and controlled by the vertical branch of the way *b b'*, and as the slide *a* in this position, or at any time while the tongue *g* is sliding into it, cannot tilt, *a* will be held entirely square while its center is approaching, coinciding with or leaving the point *c''*. Motion is imparted to the block *a* by the bent pitman *n* from a crank-pin *k* revolving with the disk wheel *l*, which may be driven by belt or otherwise. The pitman is counterbalanced by the weight *m*, so that it has no tendency to bind on its pins. The length *c k* of the pitman *n*, and the location of the center, *o*, of the crank wheel, may be chosen arbitrarily, so that the angle of direction of the force relatively to the line of the path shall not vary widely, and an easy movement may be assured. The dotted lines joining the points *k* and *c*, *k'* and *c'*, *k''* and *c''*, show the direction of the application of the force at these respective positions. The length of the pitman and the position of the center of the crank wheel being chosen, the only datum lacking is the diameter of the crank-pin circle. This circle will evidently have the point *k''* in common with an arc *n p* drawn with the radius *k'' c''* and with *c''* as a center. If a line *c k* be next drawn thru the center *o*, the point where it intersects the line *k'' c''* will be a point in the crank circle; *k k''* will be the diameter. Any desired strength may be secured by properly proportioning parts. A counterbalance *r*, shown in dotted outline, placed opposite the point *k'*, will steady the motion when turning the angle.

I will add the remark that this problem is substantially a movement I designed years ago, and which has been in operation ever since as part of the carrying mechanism of an accounting machine.

I regret to feel obliged to reject the following solutions:

H. T. Millar, Manchester, England.—The slide is liable to twist when approaching the angle of the path, and to pause while turning the angle.

Charles V. Raper, Lymm, Cheshire, England.—Mr. Raper confirms the criticisms that have been made relating to solutions No. 2 and No. 3 of this problem, but the solution he sends is deficient also in two points, viz.: it makes a sensible pause in turning the angle, and does not effect a positive stop at the ends of the path.

A number of communications have been passed over, because in some instances the drawings have not been signed as required. In such cases, when the drawings get separated from the text, I do not feel obligated to read a number of solutions in order to reunite the divorced partners. This would sometimes require a half hour, whereas, the plain signing of the sketch by the contributor would be the work of a moment. The form re-

quirements for sending in these solutions are not a matter of caprice; there is a good reason for each of them.

Jos. J. Morgan, East Providence, R. I.—Two pins are shown as holding the block square while turning the angle. Both of these pins engage the block when on the center. One will hold the block square till it reaches the corner on the horizontal branch, the other pin comes into engagement too late to prevent tilting when the block approaches the corner on the vertical branch.

J. A. Peterson, Chicago, Ill.—Sketch sent not available, some parts mentioned in the description not being shown therein, and being so inadequately described that they could not be supplied with certainty.

John H. Neild, New Bedford, Mass., makes no provision for holding the block square while turning the angle of the path.

A few have signed so carelessly and illegibly that their names could not be deciphered, and this, in one case, was done with a sketch on which the letters of reference were almost like engraved letters, while the signature was an undecipherable mesh of fancy flourishes.

Problem II.

Having now presented all the successful solutions contributed for Problem I, we can begin on the large number submitted for Problem II. The solutions of this problem are various, like those presented for Problem I; more of them are substantially alike.

This problem was presented at page 147 of the American Machinist, where any readers who missed it at the time can refer to it. I therefore will not repeat it here.

Problem II, Solution No. 1, Fig. 6. J. Melancon, Amite, La.

Altho, as will appear, the problem is susceptible of simple solutions, Mr. Melancon's solution is a good study.

"The side view of the sliding block is an equilateral quadrangle, with two angles of 60 degrees and two of 120 degrees, while the front view of the same is square, as shown in cross-section of guides. The motion of the sliding block is derived from a four-bar linkage similar to that used in F. L. Robeson's solution of Problem 1, *E* and *A* being shaft and driving crank, respectively. The stops to prevent the sliding block, when on the center, from returning over the path which it has just traversed are operated by the sliding block itself. Let us suppose sliding block *a* to be in the position shown, or at the right-hand end of its stroke. In traveling toward the center it first comes in contact with link *b*, which turns about pivot *c* and whose opposite end is pivoted centrally in stop *d*. Sliding block *a* forces this link out, thus withdrawing stop *d* and clearing the way for the sliding block to reach its central position which is at the angle of the path. As soon as *a* arrives at the central position, compression spring *e* forces stop *d* into place behind it, so that it cannot return over the path just traversed. Just before arriving at the central position, rod *f*, which projects from the bottom of *a*, as shown in the cross-sectional view, engages with lever *g*, pivoted at *h*, which raises link *i*, oscillating *j*, thus withdrawing stop *k*, and leaving the way clear for the sliding block to proceed along the left-hand branch of path. These operations are performed in reverse order on the return stroke. The slots in the ends of the links *i* and *i'* are to allow for movement of *g* and *g'* on the return stroke, when they are forced backward by the sliding block, but they are immediately pulled back into position as shown by the weak tension springs *l* and *l'*. It must be borne in mind that stop rod *m* is in the same plane as the center of the slide, and as lever *g* must be below the guides, so as to engage with rod *f*, it is seen that there must be an offset somewhere on the line; and this observation applies likewise to *m* and *g*; but one must be offset to a greater amount than the other to prevent interference. If the members *g'*, *j'*, *g* and *j* are made as shown separately in detail, all difficulty in this direction will be obviated. It will be noticed that crank *A* and link *B* are slotted. This is to allow for regulating the length of travel of the sliding block For instance, to shorten the travel, bring the sliding block to the central position as shown by dotted lines, then loosen the lock-nuts at *C* and *D* and move the crank-pin in toward the shaft *E* the required amount. Now tighten both lock-nuts and proceed. Shaft *E* may rotate in either direction. The position of this shaft could probably be located to better advantage on a vertical line thru the central position of the sliding block."

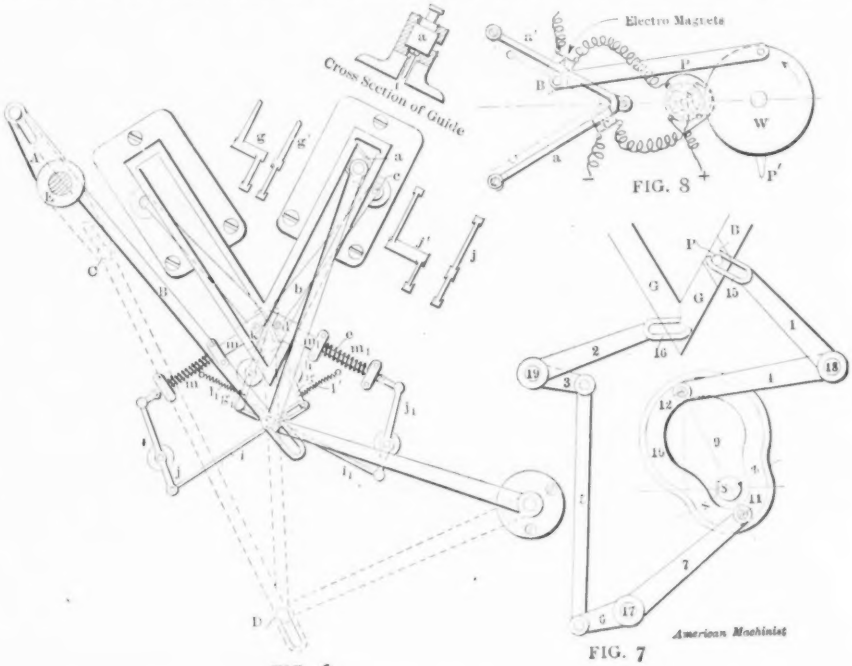


FIG. 8

FIG. 7

FIG. 6

PROBLEM NO. 2.

Problem II, Solution No. 2, Fig. 7. H. Gearing, Toronto, Canada.

It will be remembered that Mr. Gearing contributed the first solution to Problem I. He applies the same principles of construction in this solution.

The guides in which the block *B* is to move are shown at *G*. The pin *P*, attached to *B*, is twice as long as the width of the prongs 15 and 16 of the levers 1 and 2. The cam 9, revolving on the shaft 8, has a single groove 10. While the roller 12 is moving upward and downward in the groove 10 it moves lever 4 on the rocker arm 18, thus moving lever 1 up and down this and in turn imparting the sliding movement to block *B*. During this time roller 11 is on the dead part of the cam and still. When roller 12 reaches point *X*, roller 11 will have arrived at *Z*, 12 becomes dead, and 11 starts to move out rocking lever 7, which imparts a similar movement to lever 2, and there to block *B*, thru the links 3, 5, 6. The prongs 15 and 16 act as guides as the block arrives at the bottom of the slide, forming guides for both sides by acting on the pin *P*, and holding the block squarely against the lower guide. The links 3, 5, 6, could be done away with if a double-grooved cam were used, but as this would necessitate a very large cam the construction shown is the most economical in both space and material."

Problem II, Solution No. 3, Fig. 8. Ray Wilcox, Jackson, Mich.

This consists of two guides *a a'* of brass or other non-magnetic metal, set at an angle of 60 degrees, each carrying a slide with an electro-magnet *A* or *C*. The

block B is triangular and toothed on each side to engage the magnets, correspondingly toothed. The sliding block B is held to magnet A by magnetic attraction while being moved forward and back till its center coincides with the angle of the path. The reciprocating motion of B is derived from the crank disk W and pitman P. At the instant that the center of B coincides with the angle of the path, a commutator breaks the current flowing thru A and sends current thru C, releasing B from A and engaging it with C. Crank disk W drives the sliding block B

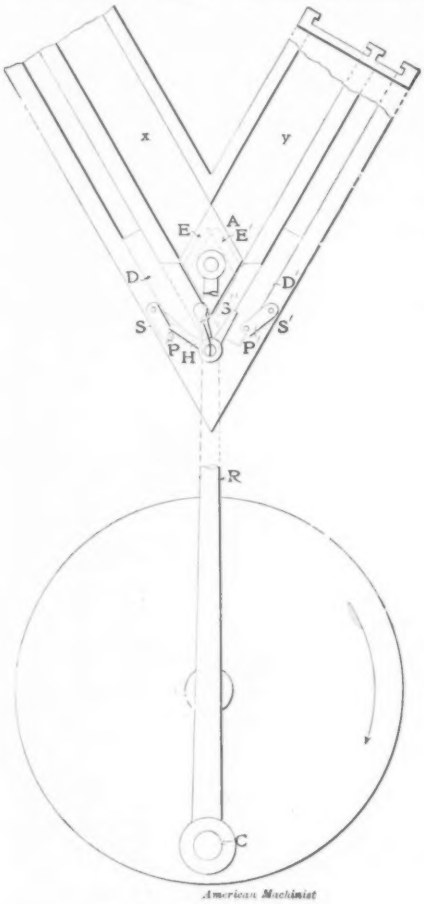


FIG. 9. PROBLEM NO. 2.

thru pitman P. The commutator is moved by a tooth P' projecting from W. For light work this might work satisfactorily.

PROBLEM II, SOLUTION NO. 4, FIG. 9. CONRAD O. LEE, RUSHFORD, MINN.

I think it doubtful whether any more satisfactory solution of this problem than that furnished by Mr. Lee will be presented. It evinces a very clear conception of the difficulty to be overcome, *i. e.*, the holding of the block in exact alinement with the path described by its center when altering the angle of the path.

"Referring to Fig. 9, the X and Y branches of the way are at an angle of 60 degrees to each other. C is a crank which rotates continuously in the same direction and transfers its motion to the block A thru the connecting rod R. D and D' are slides respectively moving in guides parallel to X and Y. Projecting from the upper sides of these slides are two pins E and E' which fit in two holes in the sliding block, as shown by the dotted lines in the sketch. These pins guide the block at the beginning of the upward, and at the end of the downward stroke, and keep the block from tilting. P and P' are pawls which hold the slides D and D' stationary when at the lower ends of the ways. These are controlled by springs S and S'. H is a lever or trip which lifts the pawls to release the slides. This is normally held with the central arm in a vertical position, by the spring S''. With the different parts of the device in the positions shown in the sketch, let the crank be turned in the direction of the arrow. This motion, being transmitted to the block by the connecting rod, causes it to move upward. As the slide D' is held stationary by the catch P', while slide D is free to move, the block moves up the guide X, carrying with it slide D, and being guided at the beginning of the stroke by the pin E'. The trip H returns to its normal position when the block has moved a short distance upward. On the return movement, as the block A nears the end of the stroke, it slides on to the pin E' and the front edge of the block carries with it the trip H. This moves the catch P' releasing slide D', while at the end of the stroke the slide D is caught and held stationary by the catch P. On the next upward stroke of the connecting rod, the slide D being held by pawl P, the block moves up the guide Y, carrying with it slide D'. During the latter part of the downward stroke the front edge of the block moves the trip H, which pushes out catch P, thus releasing slide D as it reaches the end of the stroke, while slide D' is caught and held by catch P'. Thus the first revolution of the crank moves the block up and down the guide X, while the second revolution moves it the same distance up and down Y, leaving the parts of the device in the same positions at the end of the second revolution as at the beginning of the first, and the block continues to move alternately up and down the guides X and Y as long as the crank is turned."

PROBLEM II, SOLUTION NO. 4. ROBERT P. DEANE, HOLYOKE, MASS.

A correct solution, substantially identical with that of Mr. Gearing, Fig. 7.

PROBLEM II, SOLUTION NO. 5, FIG. 10. A. L. KNIGHT, PHILADELPHIA, PA.

This is a simple solution, and will fulfill all the conditions of the problem if the workmanship be sufficiently exact. It also admits of very strong construction for the performance of very heavy work. It will rank among the best of the solutions offered.

"Lines a and a^1 are found as directed, from the center line of block a^3. The sketch shows block a^3 in a carrying bar a^4, which has an angle slot cut thru the top to fit block a^3 near to the upper end. This bar is moved by cam B running in either direction. When bar a^4 comes down to end of its stroke, bar c receives block a^2 in an angle slot nearly the same as in carrying bar a^4, but the slot is cut on the under side of carrying bar c, as is shown in the sketch. The slot D is not cut in bar c to move the block a^2, but it shows how block a^2 could be attached to some mechanism, and when either one of the carrying bars is moving, the other one can be locked by the one that is moving. With this construction, the slot for carrying bar a^4 has to be below the bottom of slot for carrying bar c, as this is not shown in the sketch."

Mr. Knight admits that there will be

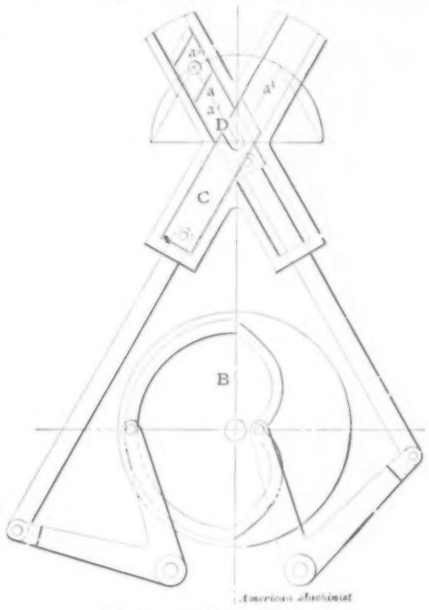


FIG. 10. PROBLEM NO. 2.

side friction in this construction, and the steeper the angle the more the friction.

The Willans Engine with Superheated Steam.

The high-speed engine made by Messrs. Willans & Robinson, Ltd., of Rugby, was undoubtedly the first high-speed engine to exhibit an economy comparable with the best ordinary slow-speed engines. The position thus taken in the days of saturated steam would seem likely to be more than maintained with the advent of superheated steam, for which the engine is, of course, particularly well adapted, there being an entire absence of flat surfaces, while the introduction of the steam centrally in place of at one side of the cylinder also minimizes distortions arising from temperature differences. It is interesting, therefore, to note some of the results obtained with this engine using superheated steam, and a record of a number of tests made is contained in a pamphlet just published by the company. The best result stated is 10 pounds of steam per brake horse-power in the case of an engine of 210 brake horse-power, using steam at 185 pounds boiler pressure, a vacuum of 28 inches, and a superheat of 260 degrees Fahr.—*Engineering*.

Shop Tools and Devices.

BY F. J. LE CARD.

Fig. 1 shows a pin vise, and the only feature that requires pointing out is the little seat at *a*. This can be used to prevent drills or wire from slipping into the chuck under end pressure. Probably everyone using chucks has noticed how much easier it is to tighten the chuck so the piece held will not turn around than to prevent its pushing in. This chuck has three narrow slits and will close up on quite a range of small work and hold tight.

I find a pin vise very useful in connection with a special centering tool for drilling small holes to a point. Having found any desired point and pricked it lightly, repunch it with the little center and ring punch *b*. The center punch being a little the longer, finds the center and the circular edge gives a concentric ring to start the drill by. Now use a sharp fine-pointed short drill in the pin vise to start a place for the drill. If not true the hole can be moved easily by pushing the drill any way required.

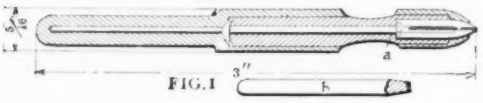


FIG. 1

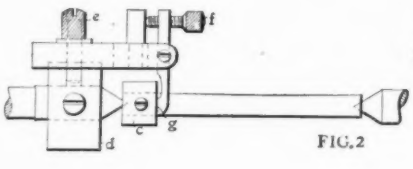
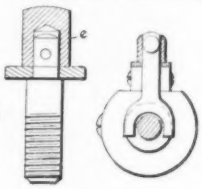


FIG. 2



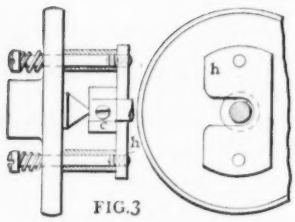


FIG. 3

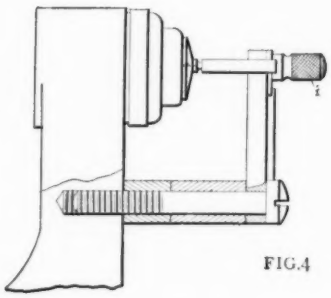
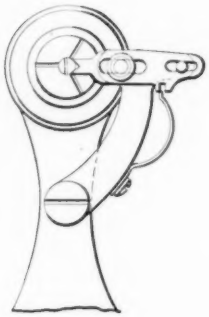


FIG. 4



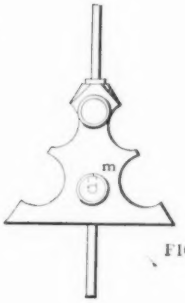
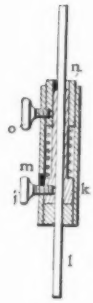


FIG. 5



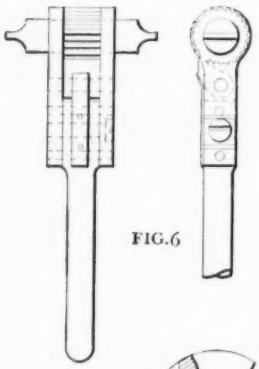
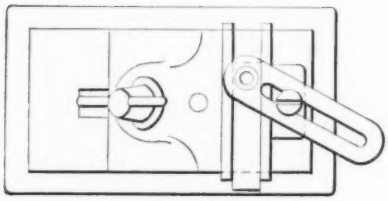


FIG. 6



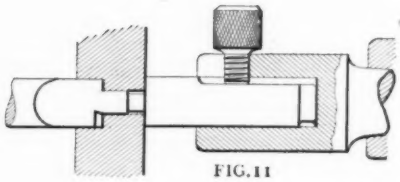
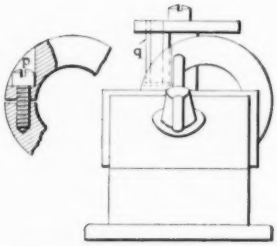


FIG. 11



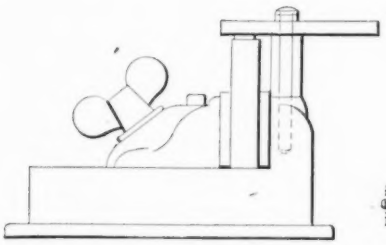


FIG. 7

FIG. 12

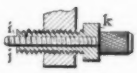


FIG. 13

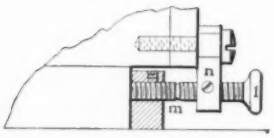


FIG. 14

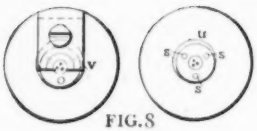


FIG. 8

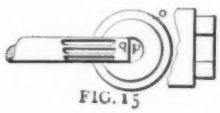


FIG. 15

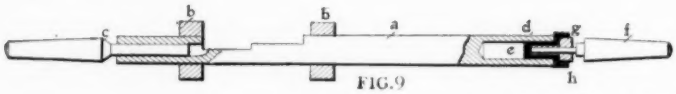


FIG. 9

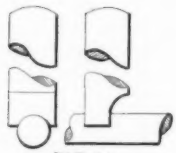


FIG. 10

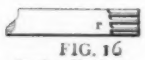


FIG. 16
American Machinist

SHOP TOOLS AND DEVICES.

DEVICES FOR HOLDING STEADY REST WORK ON THE LIVE CENTER.

Two such devices are shown in Figs. 2 and 3. The first one was found very convenient in handling a job of two hundred pieces which had to be removed and replaced several times. The steady rest is not shown, nor the pin for driving the work. I used a pin in the collar *c* which entered the piece *d*, *c* being larger than indicated in the drawing.

In working the hold-back the nurled screws *e* and *f* were loosened by hand, the work being light, and the forked clamp and its slotted carrier were removed readily, leaving collar *d* and its nurled screw in place. After drawing the work up to the center and tightening *e* a slight turn of *f* takes up the end shake. The points *g* of the yoke should be in line with the lathe center. The loose washer on *e*, as shown in the enlarged detail, lifts with the screw, and is held by the shoulder from falling down when the hold-back is removed.

Fig. 3 shows a common device for the same class of work, the plate *h* being drawn away from the center while the work is slipped in.

A BACK REST FOR LIGHT WORK.

Fig. 4 is another style of rest that I have found all right for supporting work that

is being turned or ground. In this case the tool is fastened to the headstock of a bench lathe, and a sufficient range for small work is obtained by using collars of different lengths between the head and the upright arm. The piece that supports the work can have a V, square or other notch at the open end. It has sufficient freedom on the binding post to find the work and the delicate flat spring puts it in touch with the work much better than can be done by hand. It is only necessary to tighten and loosen the screw *i* as the work is ground or turned smaller.

I ground a lot of pieces, as shown, in this way. One end of the piece had extra stock for gripping, to be broken off later, and the other was half round, with no center. It was ground the full length.

A DEPTH GAGE.

Fig. 5 illustrates a toolmaker's depth gage that I saw recently. The special feature of the instrument is this: When the screw *j*, which screws into the sleeve *k*, is tightened on *l* the depth rod, then *k* and *l* are as one piece. When they are pushed up until the screw *j* is midway up the slot *m*, the top of the sleeve *k* and the tight bush *n* are flush. They are held in this position by the screw *o* against *k* until *j* is loosened and *l* set by scale or otherwise. Then *j* is tightened and *m* released. Now, as work is faced off roughly and the gage is applied, being locked while held on the work by *o*, the tops of *k* and *n* coming together will show the progress of the work. As the tops of *n* and *k* are flush when *j* is in the center of the slot *m* and rod *l* is set, this gives a movement of about 1-16 inch each way for *k* above and below *n* and allows for removing the surface of work or deepening holes.

Fig. 6 is a handy right-and-left ratchet screwdriver, requiring no explanation.

JIG ATTACHMENT FOR VISE.

Fig. 7 gives an idea of a kind of universal jig attachment to a small Vanderbeek vise that I concocted for my own use. I have since seen a similar tool advertised in the AMERICAN MACHINIST, and I find it very useful. I have introduced one sample of the work done with it. The binding rings, one of which is shown, had been milled for the screw head at *p*. I set one right and then located my jig by this. Then I located the work by the jig bushing *q* made for the top drill and slipped the work back and drilled the tapping size hole to depth. Different length collars under the jig easily cover adjustments for hight. This tool is handy for oblique holes on round work, and a centering pin with point or half round can be used in the bushing for locating the work.

A NICE BENCH LATHE JOB.

Fig. 8 may help explain how I did a very close bench lathe job with certainty. It consisted in getting three holes .006-inch diameter equally distant from each other and 0.010 inch from the center.

I turned the piece *r* on the end of a brass rod, say ⅜ inch outside, concentric with the hole in center to receive the piece in which the small holes were to be made. Then with a center punch in the lathe tool post I marked, by using the lathe index, three points for the large holes *s* in the piece. I then soldered *r* onto a brass plate, swung up on the small face plate and bored out each hole.

I clamped a brass plate *t* onto the face plate, turned a recess *u*, .020 inch larger than *r*, then took the face plate off without removing *t*, and with *r* crowded to one side in the chamber *u*, transferred one of the holes *s* to *u*. Then pinning and clamping *r* as shown at *v*, and using the three holes successively, I got the three small holes required. They were made in a steel piece held in *r* and were about 1-16 inch deep.

The holes were spotted with a very fine-pointed graver, and the drill, which was made on the end of a piece of drill rod, was held in my fingers.

STRAIGHTENING DELICATE WORK.

While I am on the bench-lathe subject I will describe another line of work. I had two hundred pieces of drill rod worked up similar to *a*, Fig. 9. They were about 4 inches long, 0.030-inch diameter, finished, with 0.010 inch left to grind after turning off 0.020 inch; and the holes at opposite ends when done were to aline perfectly. After turning off 0.020 inch the milling cut, as shown, was made, and this of course distorted the work. The pieces were straightened with the aid of collars *b* and a brass rod fitted to the work, as shown in Fig. 10, and struck with a hammer.

I wrung the piece to be straightened onto a perfectly true plug *c*. Then rotating them by hand and using a Starrett indicator to find the defects, I commenced at the end nearest *c* and took out the kinks, moving about ½ inch at a time. In this way I brought them all within one or two thousandths at the worst places. The two collars *b* were laid on a gray-iron bench block, and the rod struck between them, some requiring several runs to straighten them. Having got them approximately straight again, I got my surface cut at the end *d* for steady-resting to bore out *c* as follows: Another arbor or plug *f* was provided with a nice-fitting sleeve *g*, and between the sleeve and the shell at *d* quite a space was left. Holding an alcohol lamp under this the space was filled with melted shellac, shown in black at *h*. A little manipulating soon tells how to fix *a* in the air, and when the shellac sets *d* can be turned true with *c*. The arbors *c* and *f* were hardened and drawn to a soft blue and remained true.

COUNTERBORE STOPS.

Fig. 11 shows a very safe way to counterbore to a positive distance from the inner face of the work, the stop being used in this case in the tailstock collet of a bench lathe.

Fig. 12 is a different form of stop for the same purpose.

SLIDE REST STOPS.

A double stop or gage for a slide rest is shown in Fig. 13. The screw *i* is located and locked with a binding screw, and the screw *j*, with a shoulder at *k*, is brought up to the latter in use and then run back out of the way.

Fig. 14 is another slide stop that has been found indispensable. I have used it on a Rivett bench-lathe milling attachment; on a slide with short movement, and with no index on the screw. Having the milling machine cutter set with the face against the work or in any other way, I bring the stop screw *l* against the gage block screw *m* and lock it with *n*. Then I run the milling machine slide back, and set the screw *m* with the micrometer in or out as required, put it back and bring the stop screw *l* up against it.

"SAFE" CUTTERS FOR MILLING SLOTS.

Figs. 15 and 16 show a pair of cutters for safe milling. For example, in Fig. 15 the sleeve *o* was to be cut open to match part way the slot *p* in the piece it had been shrunk onto. While the cutter might be set very closely if it varied but a trifle or ran out slightly, it would injure slot *p*. The smooth end *q* fitting the slot prevented this. The same idea is carried out with another cutter, Fig. 16, which is guided by surface *r*.

The Liege Exposition.

James C. McNally, United States Consul at Liege, Belgium, calls attention in *Consular Reports* to the industrial exhibition to be held in that city the present year. It is to be a "World's Fair." Great improvements throughout the entire city have been made in preparation for it, and large and handsome buildings are nearly completed. The exhibition will be held in September.

The following are among the subjects and industries embraced in the scope of the coming exhibition: Art; instruments and general processes used in education; mechanical plants and processes; engineering; means of transportation; agriculture, horticulture and arboriculture; forestry; hunting and shooting; fisheries; fruit gathering; food stuffs; mining and metallurgy; decoration and furnishings of public buildings and private houses; yarns, textile fabrics and clothing; chemical and miscellaneous industries; social economics; sanitation; public relief; trade and colonization; land and sea forces; sports; congresses and conferences.

In connection with the exposition there will be held a conference of chambers of commerce and industrial corporations.

Programs and other information may be obtained from the Bureau of Statistics, Department of Commerce and Labor, Washington, D. C.

New Pattern Milwaukee Milling Machine.

The accompanying illustrations show the most recent product of Kearney & Trecker, of Milwaukee, which has been designed with special reference to the requirements of high-speed milling cutters as regards spindle speeds, feeds and general stiffness. Apart from these features, however, it has many points of interest.

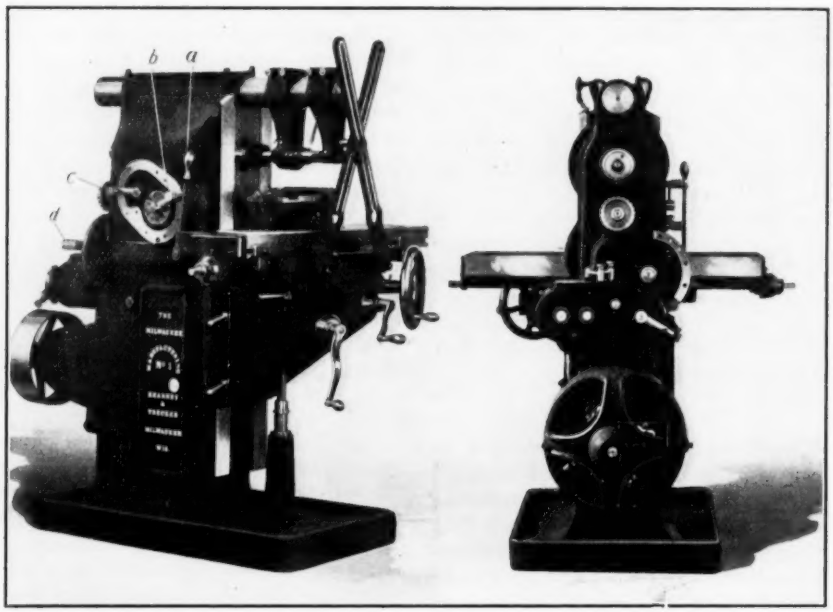


FIG. 1. FRONT VIEW.

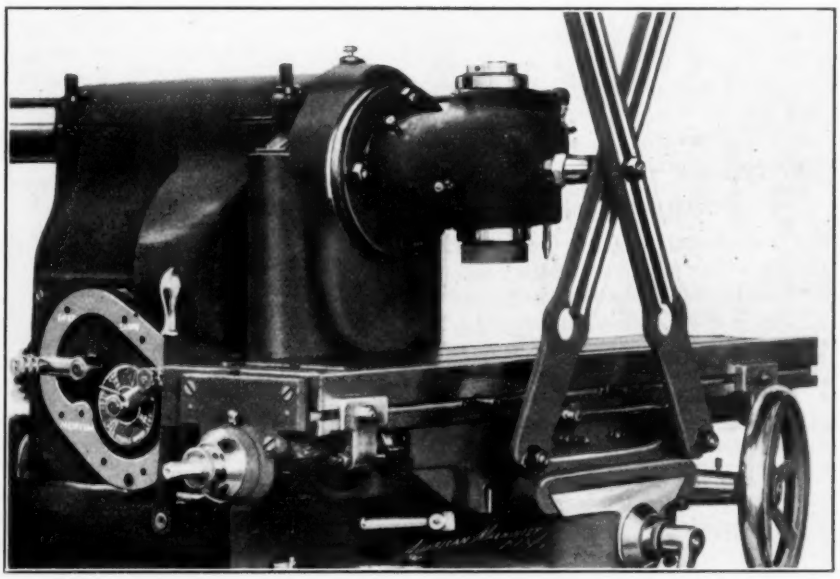


FIG. 2. REAR VIEW.

THE NEW MILWAUKEE MILLING MACHINE.

It will be apparent from the illustrations that the constant-speed single-pulley system of driving, toward which there is such an obvious tendency in machine-tool designs, has been adopted. The aim of the designer in adopting this system has been to secure the delivery of a constant horse-power to the cutter, regardless of its speed, to secure a feed arrangement giving the feed in inches per minute and to facilitate the application of motor driving, when required, by requiring the use of a simple constant-speed motor only. Of these, the first is perhaps the chief. In the nature of the system, the gear ratio increases as the cutter speed reduces or as the diameter of the cutter increases, a fact which gives a constant pulling capacity at the perifery of the cutter regardless of its diameter.

The effect of the feed-per-inch system is to reduce the range of feeds which must be provided, and thus, with a given number of feeds, to give a smaller interval between successive feeds. When the rate of feed depends on the spindle speed, it is necessary to provide fast feeds for large cutters, which are not useful for small ones, and slow feeds for small cutters, which are not useful for large ones, while with the feed independent of the spindle speed such extensions of the feed range are unnecessary. The speeds and feeds being independent of one another, and the latter having a small increment, adjustment of the two to one another is very readily made. If the work under a given combination is not smooth enough, the cutter speed may be increased without affecting the feed—the reduction in the size of the chip largely compensating for the tendency of the increased speed to heat the cutter.

When belt driven the machine is intended to be belted direct from the line shaft except when the location is such as to require a jackshaft. When motor driven the motor is intended to run constantly except when special reasons interfere. As it is thus not often used, the starting box is placed within the cabinet of the machine, altho a knife switch for stopping the motor is arranged externally. Whether driven by line shaft or motor the machine is started and stopped by the handle *a*, Fig. 1, which operates a positive clutch which, revolving at only 100 revolutions per minute, does not lead to objectionable shock. Handles *b* and *c* are for changing the speed. Handle *b* has six positions corresponding to the six steps of a cone of gears keyed fast to the shaft. Handle *c* has three positions, its function being to engage single, double and triple back gears, giving eighteen speeds in all. These range from 15 to 354 revolutions per minute, with increments of 20 per cent. Handle *d* throws the gear which is controlled by handle *b*. The acting gears only are engaged at any one time.

Twelve rates of feed are provided ranging from ½ to 16 inches per minute. The changes are made by handles on the feed box shown in Fig. 2, which also shows the method of attaching the motor when motor driving is called for. The motor is standard except for its attachment to the machine which is made to interchange with the pulley bracket and thus permit the ready conversion of machines which were originally installed with belt driving. We should say also that for belt driving a right-angle connection is provided for use when needed to place the spindle of the machine at a right angle with the shaft.

FIG. 3. VERTICAL SPINDLE ATTACHMENT.

The entire internal mechanism of the machine is subjected to flooded lubrication obtained from an oil tank and geared pump in the base, this lubrication applying to the mechanism of the feed box and to the gear teeth as well as the shaft bearings. Oil cups are used for the hand movements only.

There is also a complete circulating system for the use of oil or cutting compound on the milling cutters similar to that which has long been standard on screw machines. The makers believe they have overcome the difficulties of applying this system to the knee type of machine. A large oil channel conducts the oil to pockets at the ends of the table, from which it finds its way thru wire netting to the center of the table and to the saddle, from which a telescopic tube carries it to a reservoir in the base. This reservoir is provided with a partition in the manner now common on other machines fitted for using oil or cutting compounds. Flexible tubes are provided to deliver the oil to the cutters. The notched hand-wheel shown under the spindle in Fig. 2 is for turning the spindle by hand when necessary.

Fig. 3 shows the vertical spindle attachment and will explain why the column face dovetails are carried so high. The drive of this attachment is from a large gear screwed to the end of the main spindle which meshes with a gear on the horizontal shaft of the vertical head. Altho not shown, draw-in bars for the arbors are provided with both horizontal and vertical spindles.

The machine is made in three sizes, Nos. 1, 2 and 3, the illustrations showning the No. 1. Nos. 1 and 2 are made with or without automatic vertical and cross-feeds, while No. 3 regularly has these feeds. Nos. 2 and 3 can also be supplied with a rotary table having power feeds. When supplied with the table feed only the machines are designated as manufacturing machines, machines with all automatic feeds being called plain, to distinguish them from the universal pattern.

A London Motor Fire Engine.

London now claims to have the largest motor fire engine yet built. It is of 50 horse-power and capable of throwing 500 gallons of water a minute to a hight of 150 feet. It is propelled by a steam water-tube boiler situated between the rear wheels. It is heated by a petroleum burner of new design, in which the fuel is sprayed into the furnace. This gives a very hot fire, which can be regulated with nicety. In front of the boiler is the engine, with a pair of inverted cylinders driving two direct- and double-acting pumps. The pumps can be disconnected from the engines in a few seconds, and by throwing into gear a pinion wheel the motor drives a countershaft, from which the power is transmitted by chains to the wheels. Thus the same motor takes the vehicle to the fire and on arrival pumps the water. The engine carries enough petroleum for a 40-mile journey, and as a fresh supply of fuel can always be obtained at the scene of a fire the machine can keep going for a week if necessary. The engine is steered by handwheel. It is fitted with single solid rubber tires and "non-skids," as the risk of a side slip on the roads of the metropolis must be taken into account. A demonstration of this motor fire-engine's capability was made a few days ago. First of all, it was run up Blackheath Hill. This has a gradient of 1 foot in 9 or 10 at the steepest part, and horsed fire engines go up at a walk, with the men on foot. The motor engine went up with a full load of eight men, hose and appliances at the rate of 15 miles an hour under a full head of steam, and was gathering speed on the stiffest part of the climb. Its suction and throwing powers were also shown to be excellent.

Sheet-Metal Perforating.

BY EDWARD F. CHANDLER.

Perhaps the most important application of the ratchet feed on the power press is for perforating sheet metal. Fig. 1 is a sketch of a complete punch and die equipment. The top bolster, made of machine steel, is fastened to the plunger of the press and serves as a backing to which the punch plate or holder is fastened by screws; it is also a stop for the punches. The punch holder, also of machinery steel, is drilled to receive the punches, and upon the top the punch holes are countersunk to receive the heads. The punches being placed in these receptacles, the plate is, as stated above, securely fastened to the top bolster. Then we have the punch member complete. The punches, projecting as can be seen from the drawing, are placed in a stripper, which is drilled to match the punch plate. This stripper plate is to be fastened rigidly, by whatever means the press builder has provided, so as to stand a certain distance above the die, leaving just sufficient space for the stock to be perforated.

These little punches are cut to length from rods of tool steel, the heads being upset in a split block or heading tool, this operation being performed either in a press or with a hand hammer, preferably in a press.

The punches when headed are to be hardened. Some prefer to harden these little tools in brine, and again others use an oil bath, the color being generally a straw; this is determined by experience and a thorough knowledge of the class of work to be done. When hard, the cutting face of the punch is ground; in very large hole work the punches are advantageously ground so that the edges cut first, and again their lengths are often made different so that every other punch is of the same hight, allowing half the number of punches to enter the stock first and greatly reducing the initial strain. The punches should fit quite tight in the punch holder, but are guided by the stripper.

The die, the length of which is governed by the press capacity but may here be considered as about 30 inches, is made of tool steel. In some instances, and according to some manufacturers, it is made of the unannealed stock, and is used in this state; other die makers, nevertheless, harden the dies. These dies are sharpened by grinding the face, as in other flat dies. The shearing may be helped by rounding the face of the die so that the cross-section shows a curved top, highest at the line of holes; this is only practical in large work and is advised with caution, as in some cases anything but a flat die will buckle the stock.

The die, which is about 3/8 inch thick and 2 inches wide, is set flush in the gray-iron bolster and held in place by screws set at about 4-inch pitch. It is rather impractical to give any rule for the size of screws and parts used, as the conditions upon different presses are various. This die member is next securely fastened to the bed of the press by screws tapped into the bolster. To save drilling the bolster, a slot is cast thru its center and reinforced by webs.

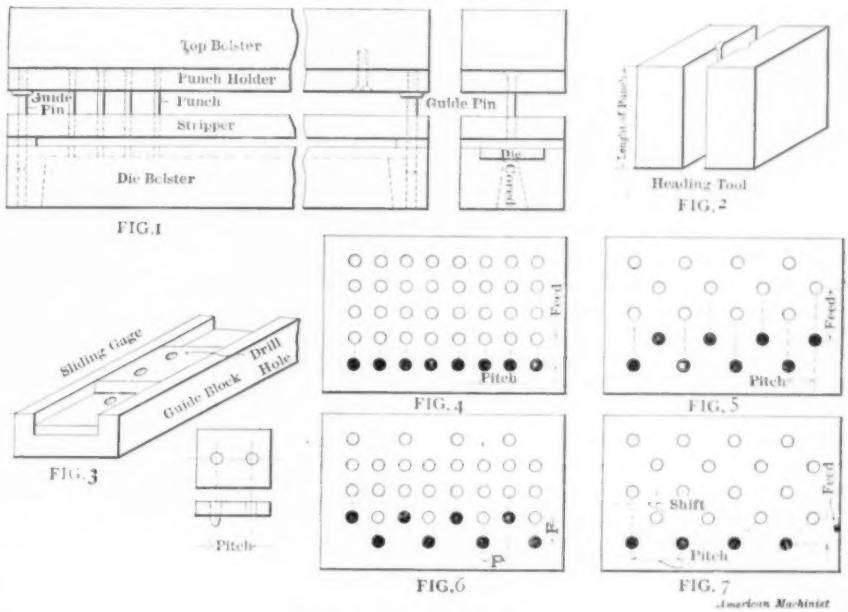


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7

SHEET METAL PERFORATING.

In drilling for this work, the stripper is drilled first and a rig like Fig. 3 is often used. The two holes in the sliding gage are spaced equal to the desired pitch, and when one hole has been drilled in the stripper the plug is dropped into it, which gages the next hole, and so on. The stripper when drilled serves as a gage for spotting the die and also the punch holder.

The dies are sometimes laid out with a single row and often with a double row of holes. In the "regular" layout, with a single row of holes and with a feed equal to the pitch, a rectangular pattern is produced as in Fig. 4. When the holes are staggered in the die as in Fig. 5, and with the feed shown, the stagger effect is produced in the perforated sheet. With the same staggered die but with half the feed the holes are in regular lines and closer together, as in Fig. 6. With a single row of holes in the die the stagger effect is produced in the sheet, as in Fig. 7, by alternate lateral shifting of the sheet in connection with the forward feed. Some presses are provided with both of these movements.

Foreign Markets for American Machinery.

One of the leading expositions of farm machinery in Cape Town has just been held. It was called the "Rose Bank Agricultural Show," and contained a first-class display of American machinery. This included a sample of the Mogul windmill, shown in working order. It is of American origin and for price and utility surpasses the ordinary British makes. One reason why United States agricultural implements take the South African market is that they suit the country, the prices, too, being reasonable, owing possibly to the fact that the American machines sold in South Africa are the same as those used in America, whereas English firms must make specially for South Africa. Tho they are not so highly finished as British makes, they are sufficiently durable. British firms do not study local wants sufficiently and should have a wider range in their machines.

Our English machinery houses are rather losing touch with the Chinese trade. The Germans, and to a lesser degree the Belgians, have secured for themselves all the Chinese Government contracts for machinery of every description, the arsenal at Hankow, the iron works and mint being fitted out with their manufactures. British firms apparently make no serious effort to push their goods in opposition to those of other countries. All they do in many instances is to send a price list to the local consular representative with a request that he will hand it on to some local agent, quite overlooking the fact that the Chinese Government prefers to deal directly with the manufacturers. Really the only effectual way to secure this class of business is to send fully accredited agents with ample particulars to the officials in charge of factories, in order to demonstrate the advantages of their machinery, to point out the superiority of the article which they are trying to sell, and to secure orders therefor.

Makers of locomotives and general railroad plant will find a market in Bulgaria. The Bulgarian Minister of Public Works has just obtained authority to expend £586,000 ($2,930,000) on locomotives and plant for Bourgas and Varna.

At Rio de Janeiro there is a large demand for iron and steel girders, especially for building purposes. Makers of forage compressors should note that the Turkish agriculturists are much more susceptible to modern machinery than heretofore. Many of those in the districts around Constantinople would be willing to purchase such compressors, as their adoption would greatly benefit Turkey, a country where fodder, straw, clover, and lucerne of good quality exist in great abundance.

The Servian Government is contemplating the extension of several light railroads. The opening will particularly apply to makers of rolling stock and metallic bridgework. The specifications and all particulars should be obtainable from the principal merchants and importers in Belgrade, or from the United States Consul in that city.

American farm machinery firms are working the Russian markets in a very systematic manner. For several years in succession one of the combines sent their representative to Russia at harvest time, and the latter worked various machines in heavy, light, wet, tangled grain, etc., and noted the manner in which the machines behaved in each case. At the end of each harvest several machines were sent back to the United States with rough, locally-made alterations. New models with the latest improvements were then made in the American factory, and these were sent to Russia for further experimental work as in the case of their predecessors, returning in due course with further suggested alterations and improvements. Of course the Russian market is just now under a cloud, but practical people know that that part of the world, also Manchuria, offers a splendid chance for the future.

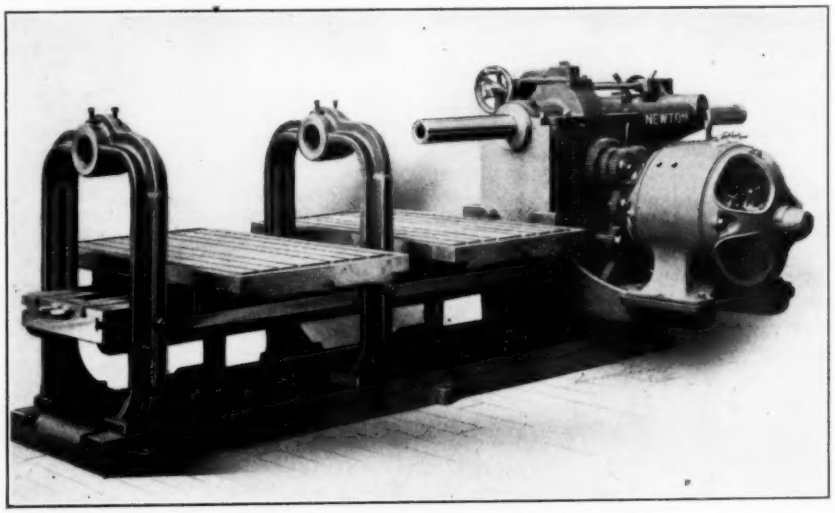
F. C. C.

London.

Double-Table Horizontal-Spindle Boring, Drilling and Milling Machine.

The accompanying illustration shows a machine designed for railroad work, especially the boring of locomotive driving boxes of which the cut extends thru part of a circle only and the method of driving is well adapted to such work. This method is by the use of a steep lead worm gear having a ratio of 11 to 1. The worm gear is of phosphor bronze and the worm of hardened steel running in an oil bath. The speed range is obtained by back gearing and a variable speed motor of 10 horse-power.

The machine is fitted with two overhead yokes to both of which the elevating knee is fitted, and the knee has two work tables. The plan of operation is to chuck a piece of work on one end of each table and then, while these are being bored, to chuck two more on the opposite ends and after the boring of the first set to traverse the tables to bring the second pair in line with the spindle and proceed with boring them, thus keeping the spindle constantly at work.



DOUBLE-TABLE HORIZONTAL-SPINDLE BORING, DRILLING AND MILLING MACHINE.

The spindle is of 5 inches diameter and has an automatic geared feed of 42 inches in six changes which are in geometrical progression and range from .0072 to .2646 inch per revolution. The table is 9 feet long and has power-driven elevating screws and hand adjustment. The work tables are 36 by 60 inches in size and have cross adjustment of 36 inches. The maximum distance from the center of the spindle to the work tables is 26 inches, and to the knee 32½ inches. The tables are fitted with automatic feed and stop for milling when desired. The machine is built by the Newton Machine Tool Works, of Philadelphia.

Letters to the Editor.

Making a Templet.

Piece *A*, Fig. 1, is a templet that was used on a certain operation in experimenting to locate certain parts accurately from a bushed .090 hole in wing *a* to a .1875 hole at right angles to it. The four holes in *A* are body size for 10-32 screws, and need not be very close; the piece that goes on is located by the .1875 hole. Wing *a* was hardened up as far as we could without hardening the thin part. There were nine of these pieces wanted. There was bushing. There were fifteen bushings made to get what I wanted. In testing roughly, I used the indicator test spoken of at page 87, and threw three of them away right off; and with the flat surface test with a finished hole cast out two more, which left me one extra one. This sounds extravagant, but I don't think it was so, considering what would have happened if I had not detected the poor ones in time. The bushings were first rough lapped, then rough ground on the outside, so they would fit a holder with a round hole to clamp them while I was lapping

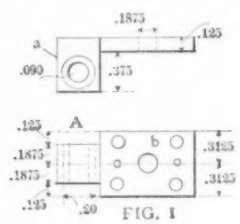


FIG. 1

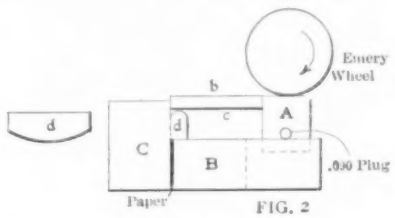


FIG. 2

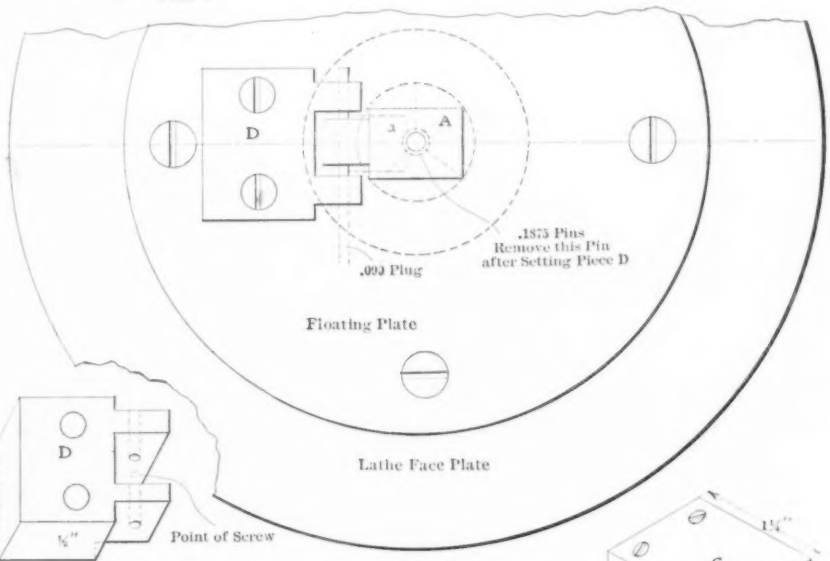
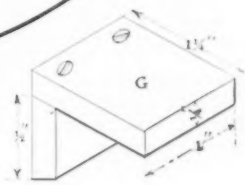


FIG. 3

FIG. 4



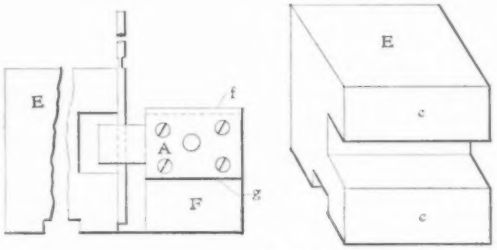


FIG. 5

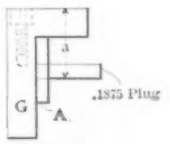


FIG. 6

TOOLS FOR MAKING A TEMPLET.

nothing out of the ordinary in machining them in the soft stage; they were left about .025 inch large, and this was found more than enough to finish to size.

The first thing we did was to lay out the four 10-32 screw holes fairly close, as we were going to use them to work piece *A* from. The hole for the bushing was laid out approximately between surplus stock; this hole was drilled and reamed on the drill press, and the screw holes were drilled; then wing *a* was hardened and the hole lapped out for the the hole; this is good practise on bushings, for if there are any surface strains you take them out, and you hold the work as true as you can get it.

After finishing and tapping the bushings home we ground surface *b* parallel with .090 plug in Fig. 2 and the proper distance from it, using a piece of gray iron milled out for the wing to enter, with a sixteenth play on a side. Piece *B* was ground in place on the chuck end so as to make contact with the other pole thru a loose piece of iron *C*, with paper between *B* and *C*. Piece *d* is a block to rest *A* on while grinding *b*, surface *C* being ground parallel with *b* by resting *b* on the chuck. About 0.002 was left to finish and correct errors liable to show in the squaring-up test.

The work was then taken to a lathe with draw-in chucks. Fig. 3 is a plan of the face-plate, with a floating or false plate attached with screws or straps. The floating plate was faced off true, and a ¼-inch hole drilled thru to let a pin held in the chuck and turned down to .1875-inch stick thru far enough to set piece *D* properly; the required distance being obtained between the .090 plug placed in *D* and the .1875 pin just turned, by using a templet (shown by dotted lines) of the right thickness to go between them. The wing *a* (Fig. 1) was set approximately central with the .1875 hole with an adjusting screw, tapped thru one side of piece *D*, as in Fig. 4. In setting wing *a* I used a line drawn across surface *C* (Fig. 2) central with the wing; then with a fine point set central, and turning the spindle half way around, I tested the setting. Piece *D* once set was not disturbed. I had to move the adjusting screw to keep within my surplus stock. Using a light strap to hold piece *A* up against the adjusting screw point, with the .090 plug in *A* and *D*, I drilled and bored the holes to size.

Piece *D* was finished the right distance from the bottom up to the .090 plug and used as a gage to test *A* when grinding surface *b*, Fig. 2; it was made of gray iron, and the .090 holes were not bushed.

Block *E*, Fig. 5, is gray iron, with face *e* square with the bottom; the channel is the right hight to allow the .090 hole to be squared up by using a plug about 1½ inches long, and tapping *A* up or down until it shuts out light when held against the block. The plug should shut out light in any of the three positions possible when on grinding block *F*. I used 6-32 machine screws to attach piece *A* to block *F* and after it was tapped square with *E* ground surface *f*; then turned the piece over on the other face, squared the plug and ground surface *g*. Surfaces *f* and *g* at this stage are parallel but at unequal distances from the center of the .1875 hole. Angle *G*, Fig. 6, is what we use for measuring from a plug up to a narrow edge. Piece *A* is shown in position to be measured over points marked *a* with a micrometer. The angle *G* is hardened steel ground and lapped and assembled as shown. After measuring these pieces I tested them by putting them on a plug and seeing if they would reverse without the edges falling or rising. Wing *a*, Fig. 1, was ground roughly, leaving .0005 on a side; then a finishing cut of .0003 was taken, which left .0002 to lap—which is all I want on a piece like this. Surfaces *f* and *g*, Fig. 5, rested on the chuck, and surfaces *b*

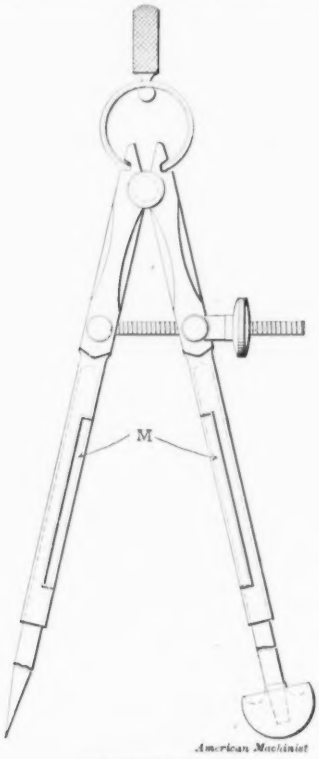
and *c*, Fig, 2, between two square parallels when grinding wing *a*.

The work was tested at every stage in making these templets in this way.

SCOTTY.

Inserted Points.

Finding it impossible, when I first started to make dies, to buy a pair of dividers with tool-steel legs, I resorted to the expedient of cutting off the points of a pair of wing dividers and drilling the legs and inserting substantial points, which I then hardened and tempered, thus making a tool which was stiff and reliable, and if for any reason the die had to go into the



INSERTED POINTS.

fire before being finished the lines could still be found as they were cut below the surface.

In the accompanying sketch I wish to show a tool which covers all the above points, and some others, in a more mechanical way. The legs are made from square tool steel; the lower ends are turned and holes are drilled up thru them about as deep and large as possible, leaving just enough thickness in the shell formed to make a stiff spring, as shown at *M*. This tongue or spring is formed by cutting thru the hollow shell of the divider leg, lengthwise and a quarter way around at both ends, and should be given a slight "set" inward before hardening in order to hold the inserted points securely in any position. The upper part of the tool is similar to that in common use and need not be described.

I have shown the ball point, one variety of point which can be used when it is desired to lay out work where the holes are already drilled, the socket allowing one leg or the other to be lengthened to suit an uneven surface. Other forms of points will suggest themselves as the need arises.

BURNBRAE.

A Pair of Combination Tools.

At page 87 was illustrated and described a V-block, and at page 159 a novel surface gage combined with an angle square. Both

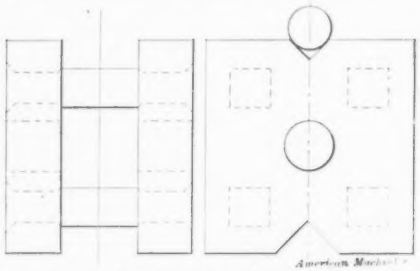


FIG. 1. DRILLING BLOCK AND ANGLE PLATE.

the V-block and the square shown are good, but, as one good turn deserves another, I would like to "butt in" with my pair of combinations. Fig. 1 is a V-block and angle plate of novel construction. It is made of cold-rolled steel 2 inches square

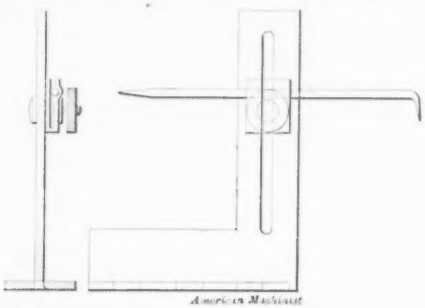


FIG. 2. COMBINATION SQUARE SURFACE GAGE BEVEL, ETC.

by ½ inch thick, pressed on the cross-bars which are ⅜ inch square, cold rolled, turned on the ends to a shoulder and riveted flush—the holes being countersunk on the outside. Two V's are cut, one for large and one for small work. The space

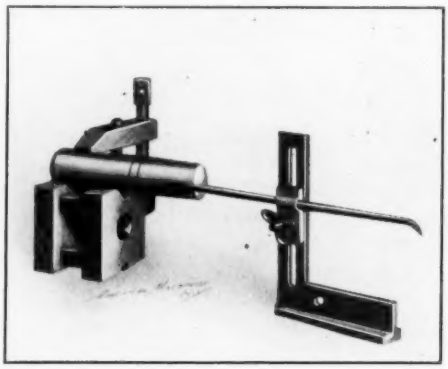


FIG. 3. THE PAIR OF COMBINATION TOOLS.

between the sides is ¾ inch. It is made square on all sides, so that when turned or rolled over, lines drawn or holes drilled will be at right angles to each other, an important feature in experimental work and small jig making.

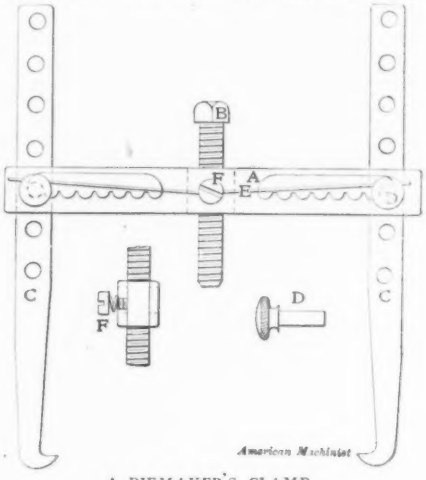
The square shown at Fig. 2 can be used the same as any square with a solid stock, for trying or laying out work. It can be used as an angle square for marking keyways on shafts. The slot in the upright blade enables us to use it as a surface gage; it can be used for a marking gage, a depth gage and, by the addition of a slotted blade, as an adjustable bevel gage.

Fig. 3 shows the pair adjusted for an operation. The center line can be scribed on both sides of the work. By turning the block over to the left, the cross line at right angles can be marked on both sides.

IM JAY KAY.

A Diemaker's Clamp.

I send a sketch of a clamp very handy for diemakers and others; it has proved useful to me on many occasions. It consists of a beam *A* drilled and slotted to take the two clamp legs *C*, with two locating pins *D*. As will be seen, it has a wide range of adjustment for both length and width. The binding or holding down



A DIEMAKER'S CLAMP.

screw *B* passing thru the center may seem unnecessarily long, but as the work of this clamp is not heavy it is handy to leave it so. The tension of the wire spring *E* serves to keep the pins *D* from dropping out when the clamp is being handled.

NOMAD.

Doing Worthless Work to Order.

I have sometimes wondered whether a man who is taking work to do for other people is justified in taking a job when he is sure that it will be a dead loss to the party ordering it.

For example, I am asked to make drawings for a new motor, but a very short examination convinces me that the whole design is so faulty from a mechanical standpoint that it is utterly impossible to make a durable machine, and, considered as a gas engine, it violates every principle of good practise.

What is the right thing to do? I am not asked to give my opinion but to do the work. If I do the work it is a waste of money to the party ordering it; if I give my candid opinion regarding it, I

probably make an enemy and the inventor goes elsewhere and gets it done anyway.

Of course it is usually the province of the man desiring to have work done to shoulder all responsibility, but, after all, ought a man to do work that he would be ashamed to have anyone know that he had aided to the extent of putting it down on paper? W. ALTON.

Cutting a Large Gear and Pinion Under Difficulties.

A short time ago we received an order for a hoist that required a gear and pinion larger than we had tools to handle, so we had to devise some way of doing the job.

The gear was of gray iron 95 inches pitch diameter, 12 inches face and 3.1416 diametral pitch. The pinion was made of cast steel 12 inches pitch diameter. The teeth were cast in both and enough stock left for finishing.

The pinion was cut on the boring mill. We used the dividing head and tail center from the milling machine for spacing it. After setting it for each cut, we placed jacks under the teeth on each side and clamps above so as to take the strain off the centers. The cutter was put on the boring bar and the slide was clamped so that the bar could not shift. The machinist put on the job got tired of feeding it by hand and arranged the simple power feed shown in Fig. 1.

To mill the gear we raised the headstock of the lathe—see Fig. 2—attached the gear

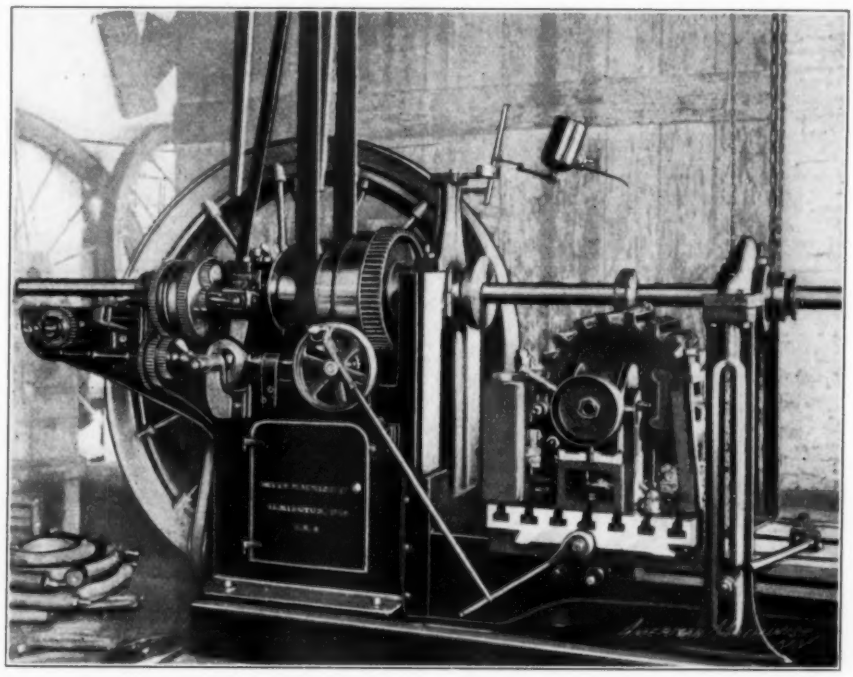


FIG. 1. SHOWING SIMPLE POWER FEED.

to the face-plate, and after turning, boring and facing it we marked off the pitch circle and with a pair of dividers laid out the centers of the teeth. We then took the table from the boring mill and attached it to the carriage of the lathe, and clamped the carriage. Had a plate cast, one end of which was attached to the table; the other end was carried on rollers and held the headstock of a lathe. We put a flange coupling on the end of the cutter bar and bolted it to the face-plate. The arbor was supported by three babbitted bearings. The cutter was fed under the gear by hand and carried the headstock with it, but the belt was long enough so that it did not cause us any trouble. At first we had trouble bracing the gear, but finally got it solid enough by putting two braces back of it and one from the tailstock to the front of it.

We have since used the boring mill for milling pieces that were too large for our milling machine. It does a good job and does it quickly. CARLOS E. HOLLEY.

Trying to Increase the Steam Pressure With Compressed Air.

The molding and foundry departments were on the first floor and the pattern shop, machine shop and assembling room were on the second. Now, in order to get the castings from the foundry to the machine shop a hydraulic elevator had been installed. It was one of those where the hydraulic pressure is obtained by means of steam pressure acting upon the water in a tank, thus forcing the water to the cylinder and so lifting the ram. It had never given any trouble.

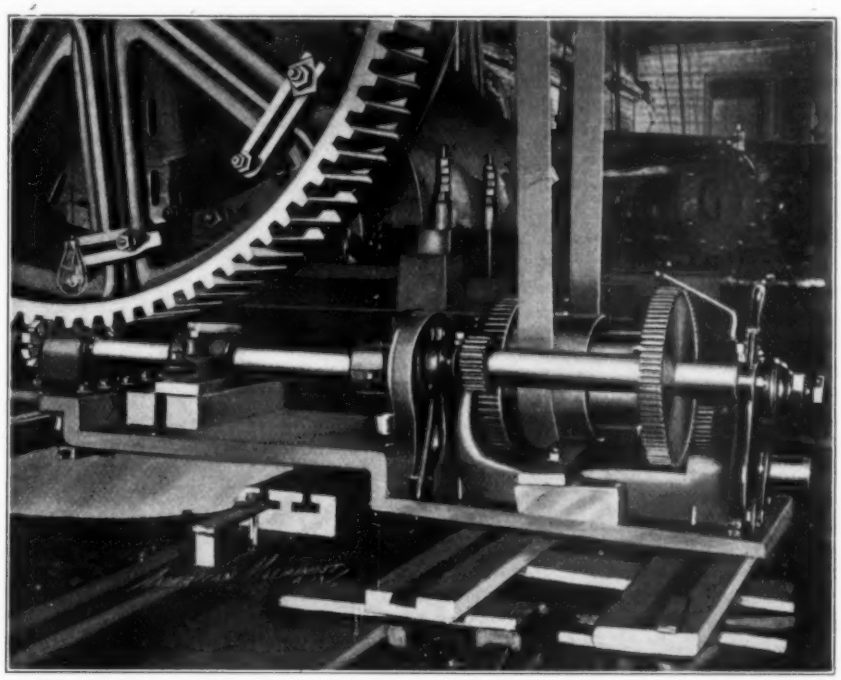


FIG. 2. SHOWING HOW THE JOB WAS DONE.

One day an order came in for an exceptionally large casting. After much trouble and many difficulties it was successfully cast and cleaned, and got upon the elevator to be taken up to the machine shop. The elevator started off in fine style, but it went slower and slower until at last it stopped about half way up. The boys said a few things about elevators and castings and opened the steam valve to its fullest extent, but still the elevator refused to move. It was let down and the ram and sides well oiled and given another trial, but beyond reaching a couple of inches higher it was no better. Ernest, who had taken a correspondence course, volunteered an explanation: "The weight of the casting almost balanced the upward pressure of the elevator and as the elevator rises the pressure of the water column plus the weight of the casting eventually balances the upward pressure of the water and so stops the elevator; if the steam pressure were increased an-

other six or seven pounds it would probably be all right." But that was out of the question, because the boss would not allow anyone to weight the safety valve down, so the boys suggested rigging up a block and tackle over the elevator and giving it some "help." At this moment Ernest was struck with an idea, and after giving the boys plenty of talk on using their brains more and their hands less, he sent Tommy for the portable sand blast air tank and told him to pump up a pressure of about 75 pounds, which would be 15 pounds higher than the steam pressure. Next the hose from it was connected to the valve in the middle of the steam pressure cylinder, and when everything was ready the steam was suddenly shut off, the contained steam keeping up 60 pounds pressure, and the air valve was opened, allowing the compressed air to rush in and "increase" the pressure another eight or ten pounds. But a most extraordinary thing happened: the gage instead of showing an increase of pressure showed a decrease, and the elevator descended some distance.

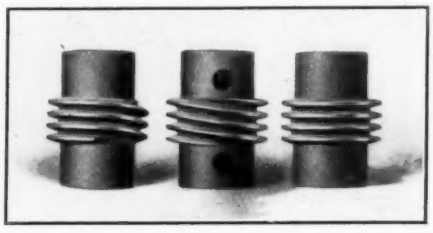
Ernest was more than astonished. He thought a little and then he said that the steam valve must leak, because he had heard the rush of air into the steam tank and so knew that more pressure had been added to the steam pressure already there, and that it "must" have increased the total pressure. So while the boys again pumped up the air Ernest cut off the steam from that line, took out the valve and put in a brand new washer. By this time the boys had pumped the air pressure to 80 pounds at the risk of exploding the whole business, and once more the experiment was repeated, but the same thing happened again. All were amazed this time and everyone was arguing about it when the superintendent came along. He quickly got possession of the facts and while he directed the boys to fix up the block and tackle and "help" the elevator he explained to them that it was impossible to increase the steam pressure by forcing in compressed air, because the moment it starts to increase the pressure the boiling point is raised and as the steam has not a sufficient quantity of heat to obtain this extra temperature it immediately commences to condense; this reduces the quantity again to where it was before, but as the air was cool it also absorbed some of the heat from the steam and so the final pressure was less than before the air was admitted. Thus the extraordinary occurrence was explained and at the same time the elevator had been persuaded by the aid of the block and tackle to lift its load.

GEO. P. PEARCE.

[The explanation given by the superintendent was probably more elaborate than the case called for. If the steam could have been compressed it would have had the temperature corresponding to the increased pressure. The air admitted, coming as it did from a portable tank, was altogether inadequate in volume and its action upon the steam was simply to condense a portion of it without being able to commensurately increase the total volume in the cylinder, as would have been required if the elevator was to rise. —Ed.]

An Intermittent Worm.

The half-tone shows three views of an intermittent worm used in a looping machine. The pitch is 1-6 inch. The dwell



AN INTERMITTENT WORM.

is two-thirds of a turn, and the advance the remaining third. It was cut on an ordinary 16 inch lathe, using a mutilated change-gear. DIXIE.

Jig for Holding Pieces of Quasi-Triangular Cross-Section in the Vise.

Having, during the past three years, to make many thin pieces of quasi-triangular cross-section, I devised the holder or jig here shown. I would have thought no more about the matter if I had not found,

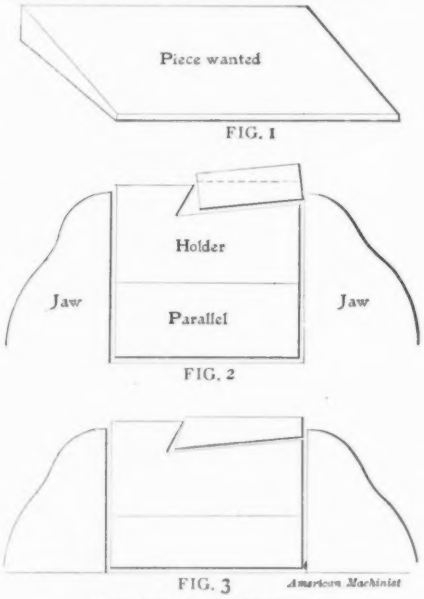


FIG. 1

FIG. 2

FIG. 3

THE PIECE AND THE JIG.

to my surprise, that no mechanic of my acquaintance had ever seen or heard of such a scheme and all had much more elaborate and less efficient ways of producing such pieces.

It seems to me that this simple device *must* have been used before by many people, but still it may be useful to some of your readers.

The piece to be made is something like Fig. 1. Fig. 2 is the first operation on a piece of rectangular section which is planed or milled to the dotted line. Then the work is inverted as in Fig. 3 and finished.

With the vise-jaws in good condition, it is possible to plane the thin edge down to less than 1-32 inch if desired. The angles are exaggerated to attract the attention.

F. H. GILE.

Business Potential.

Mr. Osborne's article at page 453 set me to thinking. Suppose a man decides to start with $20,000 capital to build corn shellers. He probably puts at least $10,000 into machine tools and ordinary small tools, and then he starts in not to manufacture but to build a few. He finds that to compete with the market he must jig his work, which he does and uses up most of his remaining $10,000. Now, when he is ready to manufacture he owns property which has cost him his $20,000, but which as soon as it has been turned over once is not salable for more than a third of that amount.

What has become of the other two-thirds, and is he justified in assuming that he has deliberately thrown it away? From Mr. Osborne's article we have to infer that he must at least represent to himself that he is that much poorer than he was at the start. With this position I can hardly agree. To my mind the position is analogous to the lifting of a heavy weight to a considerable hight and leaving it suspended there. It has cost the expenditure of considerable energy to raise the weight. It looks just as innocent of any capacity to return any energy to us in its new position as before. But we know that the weight in descending to its original position can be made to give back to us this energy, and that it can be transformed into useful work. So with our manufacturer of corn shellers. By the expenditure of much cash he has placed himself in the position where, by pressing the button and seeing that the wheels are kept properly oiled, he can retrieve his expenses and, if he is built on the business plan, add to them.

It seems to me that this man is justified in saying to himself, to the world and to his creditors, that he is worth the amount of money that he started out with, at least until time has proved his business to be a losing one, and this without even making allowance for the cost of the books wherein he keeps his accounts. They are just as essential to his business as any other tools and implements in his shop and are a part of the potential energy which he proposes to set loose to accomplish useful results.

Of course if he runs his business foolishly, equivalent to cutting the rope holding his own weight, and lets it run down or fall down without giving up every last possible ounce of energy stored, then

neither the money nor potential energy is of any avail, and he suffers a dead loss. But no man deliberately goes into business with the intention of losing everything, and his neighbors are not really justified in assuming that he will do so till he does; tho if asked to lend money, they may discount something from his statement of his affairs, in view of past experiences with new ventures.

ENTROPY.

Standards for Squares and a Lapping Fixture.

We will presume you have a fairly accurate beam square to start with to test the gray-iron angle plates *A*, Fig. 1, in the rough machine work. The chambering which is only two or three thousandths deep is ground below to reduce the surface to be lapped in correcting the angle. Grind the working surfaces *a*, Fig. 1, using the principle described at page 1335, Vol. 27, and the angle irons you are making in place of parallel *A*, Fig. 6, in that article. If after testing the planing as shown in Fig. 2 you think you can improve it in the grinding, do so; but if it is less than tissue paper would correct let it go; you can lap it easily. After you have ground the surfaces you are going to use, lap the unbroken surface flat. Now we will call this surface finished and do the correcting on the relieved surface by lapping. Be sure to make both angles the same by using the square in Fig. 3, which is adjustable to keep up with the corrections in the angle irons. If you have been lucky enough to set your square to a right angle the angle irons will form a straight line along the bottom if placed on a surface plate. Fig. 1, clamped together (your fingers will answer) and tested with a straight-edge as in Fig. 2. I find it bad practise to clamp them together and try to correct them by lapping; they will test up with the straight-edge all right, but one might be 89 degrees and the other 91 degrees. If they fit your square they will show out about twice the error of the square—if there is an error. This way of testing and this style of standard I like. You can make the first ones easy and the following angle irons need not be chambered; it makes it bad for testing squares in the inside of the blade. Fig. 3 is an old idea; the spring is "Mac's" addition to it, and I find it a big improvement. I haven't given sizes for the square, but for testing on a surface plate it is the only style to prove a square block. These standards should be kept in pairs so you can test them.

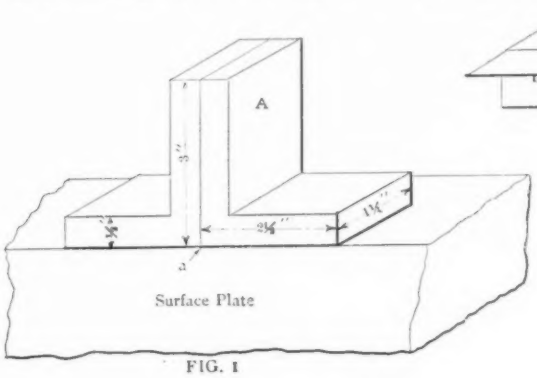


FIG. 1

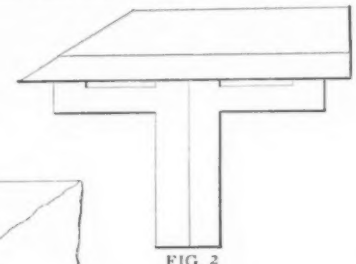


FIG. 2

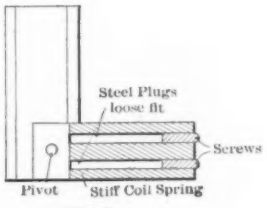


FIG. 3

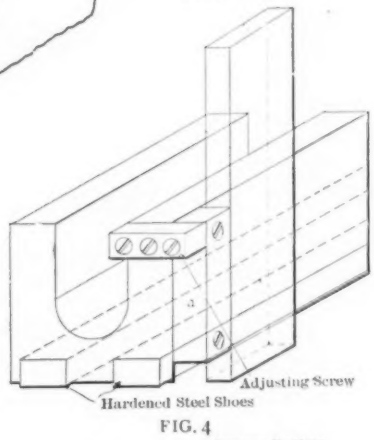


FIG. 4

STANDARDS FOR SQUARES AND A LAPPING FIXTURE.

Fig. 4 is a gray-iron lapping fixture with hardened steel shoes inserted in the bottom and held in place with hardened steel screws. These pieces must not fit tight at the sides. Piece *a* is pivoted on the lower screw, which must be a good body fit and true; the top screw works in an elongated hole and has a head large enough for a good bearing.

Piece *b* is to be lapped square on the ends and is held in the position shown by the fingers of the right hand, so there will be a pressure diagonally toward the inside corner; use rubber tips on the fingers and they will give you all the grip you want for the pressure down on the lap. This fixture will do a good job after a little practise with holding the work, and it makes a good angle iron for holding work to grind the ends square. The other side is left plain for thin pieces, which require lapping flat and square on the edges.

When laying thin pieces look out for "plowing"; if this shows up your surface will be crowning. Lap lengthwise and a little diagonally, holding the work against the fixture with your fingers; if the work is very thin and long, use a flat strip between it and the finger. This fixture, if rightly made, can be trued off on the hardened shoes (which are above the surface, about 1-16) by placing it on the opposite edges and grinding the shoes off true when they have worn out of square with the sides by use.

If in doubt about the accuracy of the grinder chuck, place a couple of pieces on the chuck and spot them off true; place your finger on them and up against the back rest, then grind the steel shoes off lengthwise.

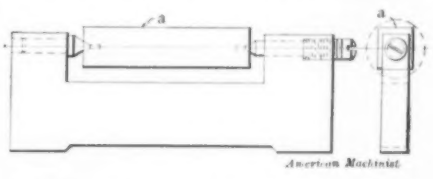
SCOTTY.

A Fixture for Milling Small Square Pieces on Centers.

One day we received an order for about one hundred pieces of round steel rod 1½ inches long and ½ inch diameter. The pieces were to be centered at both ends and flat-milled on the sides the full length on centers. The problem was how to keep the pieces from turning, as a dog could not be used to hold them, so I constructed the fixture shown.

The body of the fixture was made of machine steel milled to the required dimensions, then the long hole for the centers was drilled and reamed straight thru, after which the gap was milled in. The centers were then made of tool steel, one of them being made with a shoulder to act as a fixed center, while the other was left straight the full length so that it could slide in the hole and was adjusted by means of a small screw tapped in the hole, as shown; the fixture was then case-hardened.

Swinging one of the round pieces of work on the centers, the whole arrangement was placed in the milling machine vise and the jaws tightened on the work *a*, the fixture then acting as a parallel strip.



FIXTURE FOR MILLING SMALL SQUARE PIECES ON CENTERS.

Then taking a cut over the work it was removed from the vise and turned so that the milled face would come against the fixed jaw of the vise which would serve to index it so that the next cut would come square with the previous cut, and so on till the piece was finished.

On taking the piece from the vise, but leaving it on the centers it was calipered and found to be .002 inch tapering, which

was corrected by lapping the foot under the small end of the work.

It is only necessary for me to add that the fixture was entirely satisfactory, and the job finished in good time.

ARCH. Y.

Third Year Apprentices and "Difficult Work" —A Plea for More Practical Men.

During the last few months I have been reading with great interest the majority of the articles that have appeared in your valuable columns, and especially have I found much that has been beneficial to me in that section where are printed letters written by practical men on good, sound, practical subjects.

At page 299 there appears a well-written article on "Technical Education," by "An Instructor," presumably of one of our engineering colleges. His account of the present systems of teaching should be read by all who are interested in this subject. There is, however, one statement to which I wish to call your attention, and that is in regard to the class of work given third-year apprentices. He says in part: "Your apprentices in three years do not acquire sufficient skill so that you dare to put them on work of any difficulty." While this may, in a limited sense, be true, it does not, and cannot apply in all cases. In writing the article, our friend perchance had in mind some one of your Eastern shops, where it may be possible that a boy, while yet in his third year, is not given "work of any difficulty"; but not so in California, and being employed in a California shop, I shall endeavor to cite a few instances where his statement is not altogether correct. But perhaps "'tis the exception that proves the rule."

San Francisco has three or four "representative" shops, equipped with modern appliances, and whose class of work varies from the 3x5-inch single-cylinder engine to the monster engines of the armored cruisers "California" and "South Dakota," which are of 23,000 indic ted horse-power. On an average about sixty per cent. of the employees in the machine shops are apprentices, and it is quite natural, then, that a good portion of the difficult work falls upon their shoulders. While I was yet in my first year, I had charge of a Brown & Sharpe No. 3 universal grinder, and for three months turned all the work in this line. Shortly after this I was given small milling-machine work to do, and on one occasion fitted up a portable boring bar with cutters, etc., for boring out a badly-worn cylinder. But I am not speaking of myself alone. A few months ago a vertical blower engine for marine service was fitted and put together by an apprentice who was yet in his third year. He even had to set the valves. I might add that the engine fulfilled every requirement when steam was applied for the first time. Of course he was under the watchful eye of a foreman, but, in any case, is not the work done by even a skillful mechanic subject always to the supervision of the foreman of his department? In another instance a second-year apprentice made a complete and satisfactory job of two steam capstans. Again, there is a young apprentice at the shops who is turning up forged steel shafting six and seven inches in diameter —and the cuts that he is taking many and many a machinist whom I know personally would hardly attempt, for fear of breaking the tool. For example, he turned down a 4-inch forged steel shaft, the roughing cut of which was ¾ inch deep, feed 1-16, at 45 revolutions per minute, or a periferal speed of 47.1 feet per minute. Assuming a cubic foot of steel to weigh 490 pounds, he was removing 6 pounds of stock each minute! Of course, "Novo" tool steel was used. In one of these "representative" shops all the small pinions and gears up to 10 inches in diameter are milled on a machine operated by a lad who just the other day received his first raise in pay.

But to go beyond the three-year limit, I know of one case where an apprentice with eight months more to serve, was appointed a "straw-boss" over several machinists who had been journeymen for some time, and the class of work that he superintended was that in which the firm prided itself. And so I might go on giving other instances, but probably the above will suffice. Of course there are many apprentices who would better be at home "pitching hay," and these are the ones who are discharged immediately upon the completion of their terms of service—and upon whose dismissal the foremen breathes a sigh of relief, for there will be one less drill broken daily and one less order made out on the foundry "to replace damaged work." As a rule, however, the fourth year is a bore to the ambitious boy, and it is in this year that the employer is able to get the most benefit from him, for what is a dollar a day when we consider that the work turned out is equal to that done by a journeyman? I believe that one reason for the Western employer's giving difficult work to the apprentices is because of the fact that he has to deal with Eastern competitors, who have materials right at their very doors, as it were.

The writer of the article under discussion "hits the nail on the head" when he refers to the fact that a good many parents expect far too much of the schools to which their boys are sent, "as if," he adds, "these schools could take any kind of raw material and turn out a finished product." I know of one instance where a young fellow graduated from a preparatory institution of good standing, entered the State University, there to take a course in electrical engineering. In the three years that I had known him, previous to the time that he took up the course, he had shown absolutely no mechanical ability. He was an excellent student of mathematics, but this does not count for everything. I dare say that he will be one of those who will receive his diploma, feeling fully "competent to hold down a two-or-three-thousand dollar job," to quote again from the article.

At page 300 the writer of the article mentions the fact that one of the requirements of a successful engineer is that he be able to handle men. Who make our best foremen, managers and superintendents? In answer, I would say, "Those who have been through the mill." They are the ones who win the respect and co-operation of those whom they employ.

There are too many men in the field today who have too much theory in comparison to their practical knowledge, and then again there are a number, and I believe they are in the majority, who have too little. What is wanted is a happy medium, and the only way to attain this end is, in my opinion, and I hope your readers will agree with me, to begin at the bottom of both branches of the profession with a willingness "to get one's hands dirty." Now and again we hear of young fellows who leave our shops owing to some fickle objection on the part of their friends, but such friends are not worth the having. Modern college life is filled with too many pleasures—so many, in fact, that the average student cannot devote the necessary time to his studies, and after a young man is graduated and is brought in contact with hard work he is utterly lost, and he cannot accustom himself to it in a day.

Take a young man, place him in a shop which is known for its efficient workmanship, let him know but few holidays, and only an amount of pleasure and diversion *wholly within reason* (at the same time guarding against the mistake of making a slave of him), give him plenty of good, wholesome reading matter, including one or more engineering papers, with which to broaden his mind, and last, but by no means least, a course in one of our representative schools of correspondence instruction, and it is safe to say that the boy will turn out well, a credit to himself and to those about him—provided, of course, that he is ambitious and willing. The theory will come as fast as practise and experience will allow, and it will come to *stay*, for back of it will be the record of things accomplished, the hours of persistent toil in spite of difficulties.

He will not be among those who worry about their salary—that will come as a matter of course, for where is the employer who is not willing to offer every chance for advancement to such a fellow? If more of our young men discarded the white collar and other paraphernalia which go to make up the "dude," and donned the cap and jumper, we would not have so many fellows looking for a "soft snap."

Life is at best a struggle, and it is the hand of experience that can best deal with the many problems that confront the en-

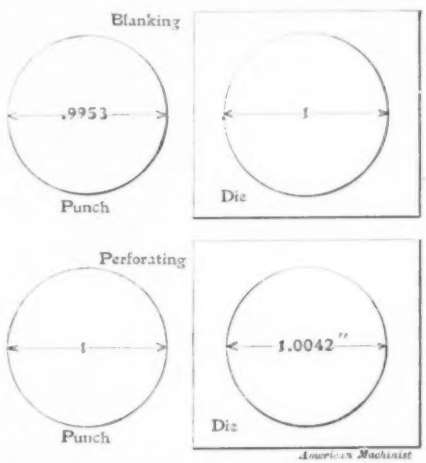
gineer, and that hand alone. This may be the age of theory, but we can still quote the old but familiar words, "Honor to the calloused hand"!

ROBERT R. HIND.

San Francisco, Cal.

A Table of Punch and Die Allowances for Accurate Work.

This letter has to do with the blanking, perforating and forming of flat stock in the power press for parts of adding machines, cash registers, typewriters, etc., and its purpose is to call attention to what is not at all new but still to many is not



SHOWING THE LOCATION OF ALLOWANCE IN BLANKING AND IN PERFORATING.

familiar, and has not to my knowledge been tabulated or put in print.

In this class of work it is generally desired to make two different kinds of cuts with the dies used. First, to leave the outside of the blank of a semi-smooth finish, with sharp corners, free from burrs and with the least amount of rounding on the cutting side. Second, to leave the holes and slots that are perforated in the parts as smooth and straight as possible, and true to size. The table given is the result of three years' experimenting on this class of work, and has stood the test of three years of use since it was compiled and it has worked out to the entire satisfaction of those who have used it.

The die always governs the size of the work passing thru it. The punch governs the size of the work that it passes thru. In blanking work the die is made to the size of the work wanted and the punch smaller. In perforating work the punch is made to size of work wanted and the die larger than the punch. The clearance between the die and punch governs the results obtained. It has been the aim in compiling the table for this class of work to put it in a simple form so that the average mechanic can make a die and be sure of the result.

The sketch shows the application of the table in determining the clearance for blanking or perforating hard rolled steel .060 inch thick. The clearance given in the table for this thickness of metal is .0042, and the sketch shows that for blanking to exactly 1 inch diameter this amount is deducted from the diameter of the punch, while for perforating the same amount is added to the diameter of the die. For a sliding fit make punch and die .00025 to .0005 inch larger; and for a driving fit make punch and die .0005 to .0015 inch smaller. The table follows:

TABLE OF ALLOWANCES FOR PUNCH AND DIE FOR DIFFERENT THICKNESS AND MATERIALS.

Thickness of Stock. Inch.	Clearance for Brass and Soft Steel. Inch.	Clearance for Medium Rolled Steel. Inch.	Clearance for Hard Rolled Steel. Inch.
.010	.0005	.0006	.0007
.020	.001	.0012	.0014
.030	.0015	.0018	.0021
.040	.002	.0024	.0028
.050	.0025	.003	.0035
.060	.003	.0036	.0042
.070	.0035	.0042	.0049
.080	.004	.0048	.0056
.090	.0045	.0054	.0063
.100	.005	.006	.007
.110	.0055	.0066	.0077
.120	.006	.0072	.0084
.130	.0065	.0078	.0091
.140	.007	.0084	.0098
.150	.0075	.009	.0105
.160	.008	.0096	.0112
.170	.0085	.0102	.0119
.180	.009	.0108	.0126
.190	.0095	.0114	.0133
.200	.010	.012	.014

St. Louis, Mo. E. DEAN.

[In connection with this letter our correspondent has sent us a sample of work. It is a piece of flat steel about .04 inch thick of irregular shape, with a perimeter of more than 2 feet and with 43 holes and notches of 12 different shapes and sizes. It is from a die which made 19,000 cuts before it broke, and the sample is just as the die left it. The die had been in use two years before the sample was made. It is a fine example of power press work. No burr is discernable by the eye, but the finger nail will just detect it. As a halftone would not reveal the excellence of the work, it would be useless to show it.—Ed.]

Adjustable Sizing Block.

Fig. 1 shows a sizing block which I made for use on the planer. The body of the tool *A* is made of machine steel. After the slot is cut in it, the machine steel piece *B* with the foot *C* is fitted to it a nice snug sliding fit. The hole *D* is then drilled and tapped ½ inch twenty threads, and is so located that only about one-fourth the circumference of the tap cuts into *B*. *B* is then removed and a ½-inch rose bit is run down into the hole in *A*, cutting the threads away. The steel screw, Fig. 2, ½ inch diameter, twenty threads, is then made. At its lower end is the V-groove *F*, into which the screw *E* engages when the tool is assembled. A groove *G* is milled in the piece *B*, so that the screw *H* may hold *B* in *A* and allow it to slide up and down freely without binding on the screw, Fig. 2. An index-point is fastened to the top of *A* and reaches up to the divided collar on Fig. 2. This collar is divided into fifty parts, and as the screw is twenty threads each division equals .001. The face *I* of body *A* is graduated to twentieths and tenths, which may be easily done if left till the last by using the tool itself for spacing. The foot *C* and the top of the sliding block *B* are used for sizing. The capacity of the tool as shown is from ¼ to 3¼ inches, by thousandths. E. F. BOWLEY.

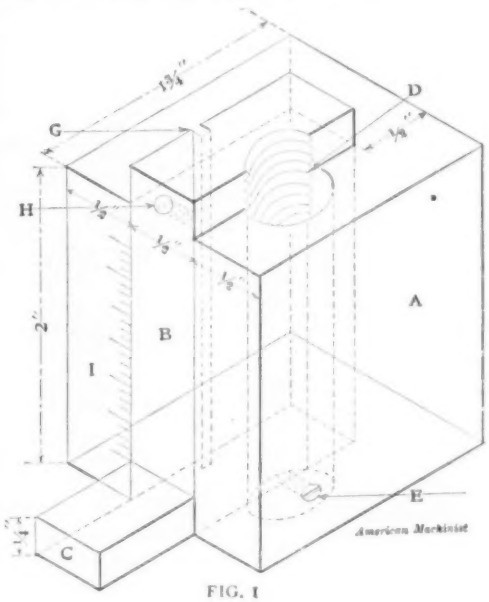


FIG. 1

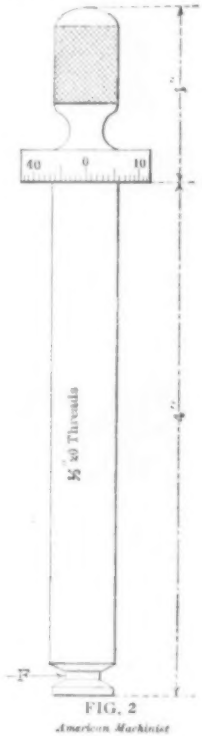
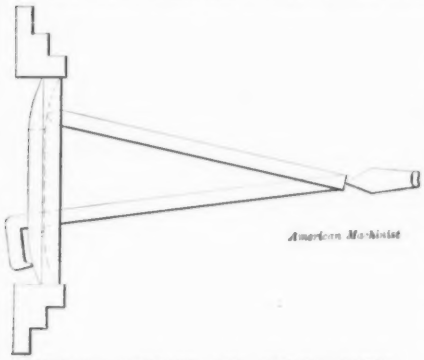


FIG. 2

ADJUSTABLE SIZING BLOCK.

Turning Concave and Convex Rings.

Having had concave rings to turn in an ordinary lathe, I made my tools the length of the radius of the circle to be turned, with a small center in the back end. This I placed against the tail center and thru the tool-post, clamped it lightly and fed

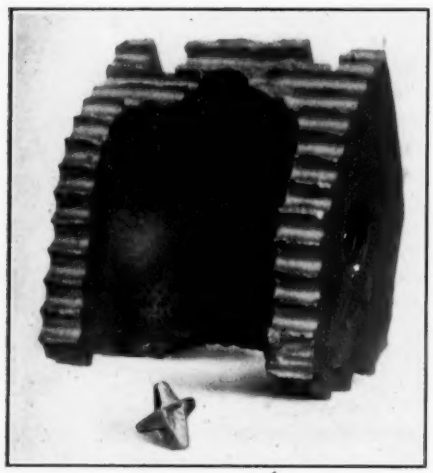


TURNING CONCAVE AND CONVEX RINGS.

it across. In using the hook tool for the back side of rings it is clamped to the tail center to prevent pulling. A. B.

Internal Abrasion of a Piston.

I send you a piece cut from the piston of the A. I. Root Company's 300 horse-power engine. We bored out our cylinder and made a new piston and a new set of rings and had the engine running in A1 style, when, about a month later, the engineer heard a peculiar noise in the cylinder. He stopped and examined the engine and found a hole in the piston and on further examination found a "jack" or star, which I send with the section of piston. This jack, it seems, got into the casting in the foundry and was not noticed when we bored and turned it—that is, we heard no rattling and had no idea that



INTERNAL ABRASION OF A PISTON.

there was any foreign substance inside. But this jack evidently got loose, and the action of the piston kept the jack going back and forth until it actually wore a hole thru the piston and let it and a lot of grit into the cylinder. We plugged the hole, as you see, but the cylinder was so badly damaged that we again had to bore it and put in a new piston, but this time to prevent the jack trouble we filled the piston with mineral wool.

F. G. MARBACH,
Medina, O. Master Mechanic.

A Graphic Job Time-Card—Electric Lighting of Workshops.

Determining the exact cost of a job is always a difficulty in running an engineering shop, particularly if work of various kinds is undertaken by the same man and each piece requires only a short period of attention. The tendency is, of course, for the man, before making a return, to make a rough cast, and then adjust the figures according, not to the time actually taken, but to the time which he considers should have been taken. A job time-card employed by Joshua Buckton & Co., Leeds, the well-known makers of testing ma-

Man's Shop No. JOB TIME CARD. *Order No.*

Name *Machine*

Machine No.

Work to be Machined

Instructions or Remarks

Drawing No. *Work given out by*

Piece No. *Examined by*

DATE 6-0 6-30 7-0 7-30 8-0 8-30 9-0 9-30 10-0 10-30 11-0 11-30 12-0 12-30 1-0 1-30 2-0 2-30 3-0 3-30 4-0 4-30 5-0 Overtime

American Machinist

Total Hours

A GRAPHIC TIME CARD.

chinery and machine tools generally, is here given, and, inasmuch as the record is graphic, it may tend to give accurate figures within its limits. The card explains itself. It gives particulars of the man and his machine, with a space for details of the job and for any instructions. Below this are spaces for the drawing numbers and for the names of the officials responsible for giving out the work and for examining the job when it is completed. At the base is a tabular arrangement, divided into quarter hours, according to the time worked, the thick lines distinguishing the hours and also 8.30, one limit of the breakfast period. Horizontally the diagram is divided according to the date, and in the spaces resulting a man makes a pencil record of the times taken on the particular job to which his time-card applies. For instance, if, on a given morning, he commenced the job at 6 o'clock and worked till 7.30, he would draw a horizontal line in pencil from the 6 to 7.30 vertical line, other records of the same job being similarly made on the same card, according to the dates on which the work was undertaken. A special space is left for overtime, and a line marks the total hours taken on the job as graphically recorded. The back of the time-card is quite plain, but at the bottom it is gummed, to hold the sketch to which the machine man is to work. This is supplied as a blue or white print from the drawing office, and it often avoids the necessity for making any statement under the head of "Work to be machined" and "Instructions or Remarks." These cards are placed in an open cupboard bearing suitable shelves, each machine having its own space, which is marked. The foreman, when he receives a number of job cards, sorts them out according to the machines suitable and places them in appropriate slots at his leisure. Then the workman, if for any reason he falls short of a job, can go to this cupboard, where he will find instructions regarding his work already arranged for him.

Perhaps, if the shunt is not too rapid, some remarks may be made on the lighting of workshops. At the Phoenix Dynamo Manufacturing Co., Ltd., Thornbury, Bradford, arc lamps have been in use. The shops have been specially equipped for their purpose; they are well ventilated and are in the daytime lighted by means of a glazed roof. Of course inverted arc lamps could not be used. Instead, ordinary arcs, both open and enclosed, have been employed, but have recently given way to incandescent lamps. Owing to atmospheric changes, the larger lamps required considerable attention, and the

enclosed arcs were found particularly troublesome, owing to the internal globes breaking. The change has been made at the rate of five clusters, each of eight lamps of 16-candle-power, in place of four 10-ampere arcs run in series. For the smaller lamps ordinary deck fittings, costing about 28 shillings, have been employed, the wiring and switch for each cluster costing about 7 shillings. For locating the lights and for running overtime with any particular machine or set of machines, instead of the whole shop, the advantages are plain. Finally, it is found that the lighting is more economical as regards running cost, the practise being to use cheap 220-volt lamps, which, for higher efficiency in watts per candle-power, are overrun at 230 volts.

London. I. WILLIAM CHUBB.

A Backing-Off Attachment.

The photograph, Fig. 1, shows a backing-off attachment which, while not making cutters exactly correct, will make them good enough for general work. It is easily made in a few hours, and its cost is very small. It will back off cutters of any shape and number of teeth without any gearing whatever. The photograph shows the attachment fitted to an 18-inch lathe, backing off a half-round cutter ½ inch wide by 3 inches diameter, having thirteen teeth and a 1-inch hole. The mandrel, Fig. 2, is of cast steel with the ends hardened and its centers are ⅜ inch off the true center. It was necessary to make a cast-steel cap to screw on the threaded end, otherwise the center would break out. The other end being larger in diameter did not require a cap. A gray-iron collar is shrunk on the mandrel to carry the pin that drives the cutter. Fig. 3 is the machine-steel arm that is keyed to the mandrel, and Fig. 4 is a cast-steel eccentric that gives the mandrel its reciprocating motion. The center is ⅝ inch from the true center. Fig. 5 is a gray-iron upright whose base is bolted to the bed of the lathe. The photograph shows the tool-holder quite clearly, and, as will be seen, the tool is pivoted so that it will lift up on the back stroke. The gray-iron block that carries the tool was made for another purpose, but by putting in the studs for the tool it answered for this job very nicely. When you wish to back off cutters with this device, you chuck the cast-steel eccentric so that its pointed center runs true when projecting about 1½ inches from the chuck. Next put on the gray-iron upright and bolt it firmly to the bed of the lathe, put your mandrel between the centers and you are ready to proceed with the cutter. It is surprising how quickly you can finish a cutter with this apparatus. A good feature of the rig is the quick return of the mandrel to its starting point, due to the eccentric being at its lowest point when the mandrel is moving back.

E. H.

Brantford, Canada.

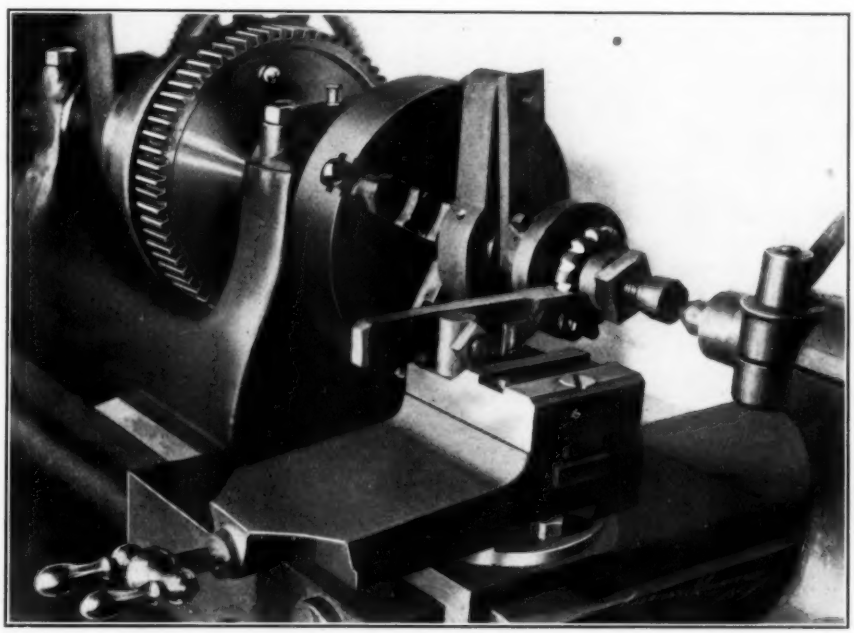


FIG. 1. BACKING-OFF ATTACHMENT FITTED TO LATHE.

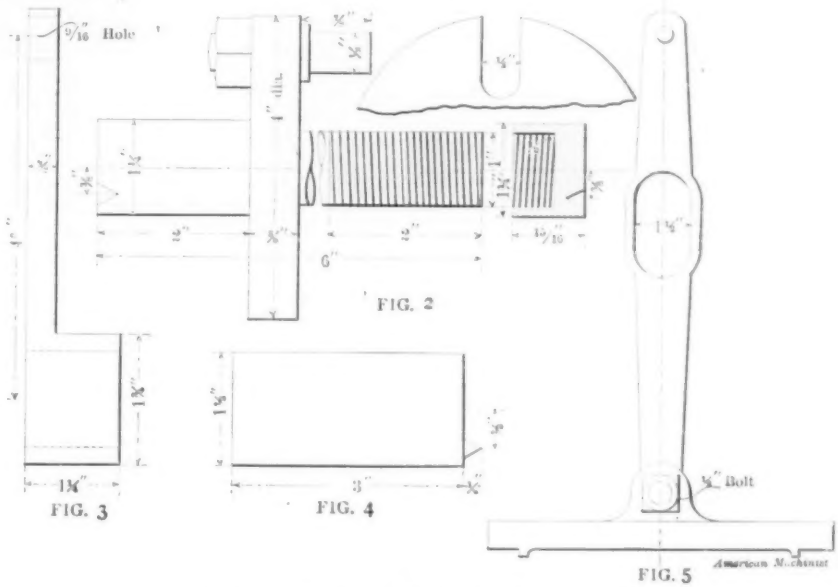


FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 2. DETAILS OF BACKING-OFF ATTACHMENT.

A Noon-Hour Shop Yarn.

The temperature outside was about 15 degrees. It was the noon hour; all of us had eaten our lunch, and we were now huddled around the old forge for a skin roast and a smoke, and also to listen to Bill's story, for it was his turn to entertain us to-day. Now, Bill was an Irishman with a decided brogue, which his twenty years in this country had not caused him to part with; but for the sake of time, I will omit the brogue from the following story, telling it otherwise as near as I can remember the way Bill told it that day.

"You see, it was this way," he began. "I had been working in Cleveland, Ohio, for some time, when things began to get dull, so, having a little money, I thought I would take a trip to New York, with the idea of working there awhile; and suiting the action to the thought, I was next day en route. Well, after reaching New York, the first thing I did was to hie myself down to the old shop district and hunt for a job. Altho I had a little money, one can get rid of it so quickly in New York that I felt there was no time to be lost. Well, I met with very poor success at first, but after several hours I bunked up against just what I was looking for, a job where the services of a first-class all-'round machinist and toolmaker were needed, with now and then a job at repairing engines, dynamos and the like. I surmised it was the foreman that I was talking to. He was a great big, impressive-looking fellow, with a great stock of trade expressions. While talking to him

I sized him up pretty well, and I said to myself, 'I haven't traveled all over the country for nothing, and I've got you down for a bluff.'

"Well, to make a short story longer, I went to work the next day, and very much to my surprise I was given the job of facing up some nuts on a screw mandrel. 'Golly,' says I, 'this makes me feel like a boy again.' Well, the jobs I got for the next two months required no more skill than the first one, and I was beginning to despair of ever seeing any of the work requiring the services of a first-class mechanic, when one day the boss came rushing up to me with a 'Hey, Bill, here's a job in a dickens of a hurry; I want six name plates,' and he gave me a list containing the lettering he wanted done on the plates, and says he, 'You can use the ordinary three-sixteenths letters we have in the tool room.' Nearly everything they had in the tool room had seen better days. So I cut up the plates from a sheet of brass, and finished them up as far as the lettering, but then I found I could not letter them, for some of the letters of the only set they had were broken and some were missing entirely. So I found the boss and explaind the case to him.

"'Well,' says he, 'how many did you say were missing? Four?'

"'Yes, sir.'

"'Well, make four new ones, then.'

"'But,' says I, 'I have not the tools I need to make them, and, besides, I did not hire in here as a letter cutter; that is a trade by itself, and it would take me a half day to find some stock and forge up the chisels I would need. Besides that, I need some small files and hand tools, and by the time it would take me to prepare to cut the letters you could send out and buy a dozen sets of letters. It wouldn't pay to make them, sir,' said I.

"'Well,' says he, 'What is the matter? Are you trying to get out of making them? Can't you do it? You claim to be a first-class machinist and toolmaker, don't you? We can't send out and buy them; you will have to make them.'

"'Well, sir,' says I, 'I have cut thousands of them before now, and I can cut as many as you wish' (at the same time I had never cut one in my life.)

"I got to work and made the little chisels, and scraped up some small files, and found some square steel for the letters, and I guess I spent about half a day doing it: but time made no difference in that shop, so I did not hurry myself. The truth is, I did not want to start cutting the letters until after I had a chance to see my friend Finnegan that evening. You see Finnegan kept a good hardware store. Well, I called on him that evening at his store, and told him my trouble, and did he have any three-sixteenths letters in the place?

"'Sure thing,' says he; and with that he handed me down from way up on the shelf a box containing a lot of assorted letters of all kinds and descriptions. I soon found what I wanted and bid him good night. After I got home I annealed the letters (which were new ones) in the coal fire, and took them to the shop with me next morning. It happened that the boss was in the habit of looking after a good deal of outside work, which took him away from the shop three and four hours at a stretch. This happened sometimes for days hand running, and it happened to be the case on that morning. While he was out I took one letter from my pocket and proceeded to brighten it up in the vise, being very careful not to touch the edge of the letter for fear of spoiling it. In the meantime I left three blanks lying on the bench by the vise in plain sight, so that in case the boss came around he would not tumble to my little game.

"After three or four hours he came around and walked over to see how I was getting along, and was pleased to see that I had one almost done. Of course whenever he came around I was either making a bluff at filing the ins and outs, or else I was rubbing them up with emery cloth. Sometimes I'd walk away from the vise when I saw him coming, and I'd wait till he made himself scarce. About every three or four hours I would take another letter from my pocket and dispose of one more blank, until finally at the end of two days I took them to the boss for inspection before hardening them.

"Well, he held the letters between the thumb and forefinger of his left hand, so that they appeared like this, B, C, M, P, and holding them off at arms length he sized them up with his mechanical eye.

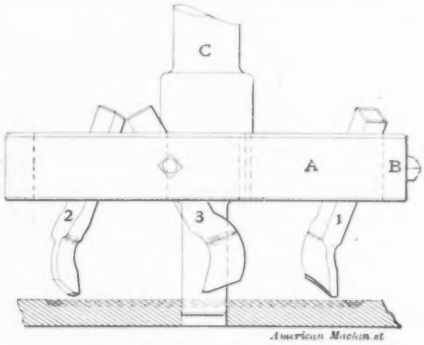
"'Well,' says he, 'do you call yourself a toolmaker, or did you make these with your eyes shut?' and taking a lead pencil from his pocket he said: 'Any boy could make letters more uniform than that. Can't you see that you have this one too fat on this side and too slim on this, and don't you see the M is crooked and the P is too sharp here? The C is about the only decent looking one of the lot. Now take them back to your bench and correct the faults I have shown you, and then let me see them again.' Well, I had more regard for the good judgment of the man who made the letters than I had for my boss's opinion; so, when I got back to the bench, I only made a bluff at touching them up here and there. The truth is I was afraid to touch them for fear I'd spoil them; so, after about an hour or so, I took them back to the boss for another inspection. This time he eyed them up the same as before and then he said: 'Now they look something like letters; why weren't they as good the first time you brought them to me?' 'Well,' says I, 'I thought they were in a hurry and I would not spend too much time on them.' 'Oh,' said he, 'it is better to spend a whole hour too long and have them right than to hurry too much and have them wrong; that is the policy I run this shop on and I have not had a kick coming yet.' 'You're all right, sir,' says I, 'but I learned in one shop that sometimes it pays to get a wiggle on.'

"I guess the company must have waked up shortly after that, for about two weeks after that I saw just what I had expected would happen sooner or later. There was a new boss, and the old one had a jumper on, and was tying to do a job in the lathe. The job did not stay there long, for I soon saw it fly out of the chuck and on to the floor. Another week passed and he was put to work on the bench alongside of me. I soon found he couldn't even file straight, and one day while in a talkative mood I told him about the letters, and he nearly split his sides laughing. Well, he was no mechanic, and before another month was over he was packing up his things to get out, and when I asked him what the trouble was, he said they had cut him to $2.50 per day and he couldn't stand such small money, and he thought he would look up another foreman's job somewhere; that all one needs is a little nerve and the money's twice as good. Ah! there goes the bell, and it's your turn to-morrow, Tom," said Bill, slapping Tom on the back. R. B. BOONE.

An Improved Flue-Hole Cutter.

The illustration shows improved flue hole cutter which I think may interest some of your readers who have much of this kind of work to do.

A is a Bessemer steel machine finished



AN IMPROVED FLUE-HOLE CUTTER.

forging. *B* is a Bessemer steel ring shrunk upon *A*—after the tool slots in *A* have been made—thru which the tool binding set-crews are tapped. *C* is of stool steel, and made a press fit where entering *A;* it is also keyed to *A*. *C* is turned and ground for No. 5 Morse taper, the lower or pilot end of *C* being hardened and ground to 1 inch diameter, and is sufficiently long to well enter the hole in the plate to be cut, before the tools shall engage with work.

The tools are placed 120 degrees from each other. It will be noticed that the tools are placed at such an angle (30 degrees) that the cutting edge of the tool is on a line with the tool fulcrum. This very much lessens the chances of breaking the tool by "gouging" or otherwise, as is often the case when the tools are at right

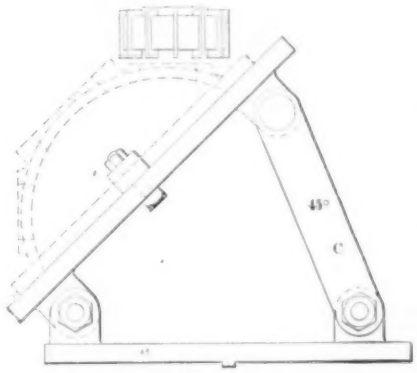
angles with *A*. The tool stock is ½x⅝-inch high-speed steel, and so formed as to give strength where most needed.

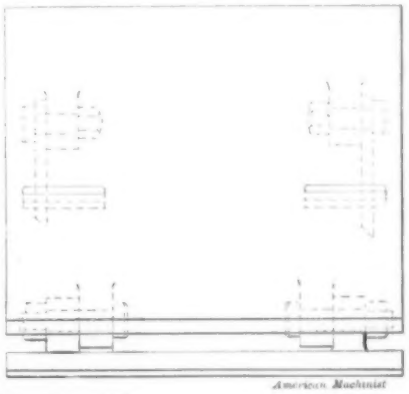
The sketch shows cutters making a 6¾-inch hole. No. 1 tool is the first to come into contact with the work, and the corners of the tool are relieved so that a groove ⅛ inch wide is made. No. 2 is a ¼-inch square-nose tool, and cuts behind No. 1 1-64 inch, as does No. 3 cut behind No. 2. No. 3 tool is 5-16 inch wide. It will be seen that each tool makes clearances for the following tool. A section of ⅝-inch plate is shown, the tools having been withdrawn from the work. We found it necessary to employ a heavy drill press in connection with this cutter when boring holes, as the high speed used (60 feet per minute), and the coarse feed (.008 inch per revolution) were too much for the power of the smaller drill presses. At this speed we could count upon thirty holes per hour. A soapy water was used as a lubricant. BECK.

An Interesting Drawing-Press Movement.

American patent No. 562,360 was granted on a movement for blank holders of drawing presses which has been successfully used for presses with movable blank-holder slides on the top and stationary beds. The accompanying illustrations, Figs. 1, 2 and 3, show diagrammatically a drawing press with a movable bed driven by the same mechanism. The diagram, Fig. 4, has been obtained from the actual proportions of the Figs. 1, 2 and 3, and explains itself.

The movement of the top crankshaft is transmitted to the bed *B* and the die *D* by a connecting rod *C*, a sector *E*, and a gear *F*, driving a rockshaft *G*. At the right end of *G* there is a crank *A* around whose pin *H* a link piece *I* swings freely. The pivot *K* connecting the link *I* with the toggle *L* stands out of *I* and projects into the channel *M* of the crank *A*, thereby holding the bottom crankshaft and bed *B* stationary during the drawing operation that is giving the top dwell. *I* and *L* together form a jointed connecting rod. The bottom dwell of the bed is gained by properly fixing the angle of rotation of the shaft *G* and crank *A*. In the drafting office in which this press was designed some difference of opinion arose as to whether the design provides for a bottom dwell of the bed and so gives time for feeding the material. J. C.





AN ADJUSTABLE ANGLE PLATE.

An Adjustable Angle Plate.

I have obtained very good results from using the angle plate, as per sketch, upon planers, milling machines and drill presses, and while I do not claim or call it universal, any angle desired can be obtained by making tie bars *C* for such angle. *A* and *B* are gray-iron castings, machined and fitted together by a hinge thru which is a finished 1¼-inch bolt. At the opposite edge of the angle plate from the hinge are lugs cast upon *A*, corresponding with lugs upon *B*, the two being connected by the tie bar *C* made of 1x3-inch machinery steel bolted to the lugs, as shown. The sketch shows angle plate set at 45 degrees. The broken lines indicate a steam pump valve chest cover

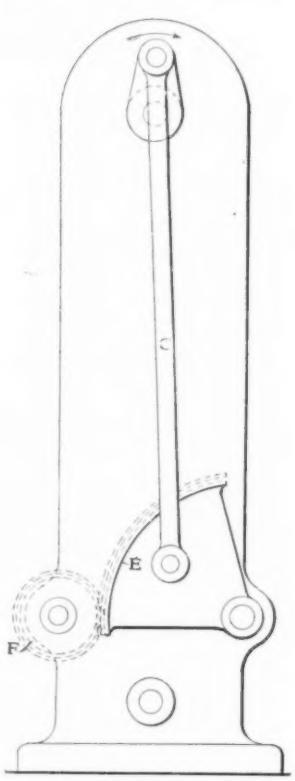


FIG. 1

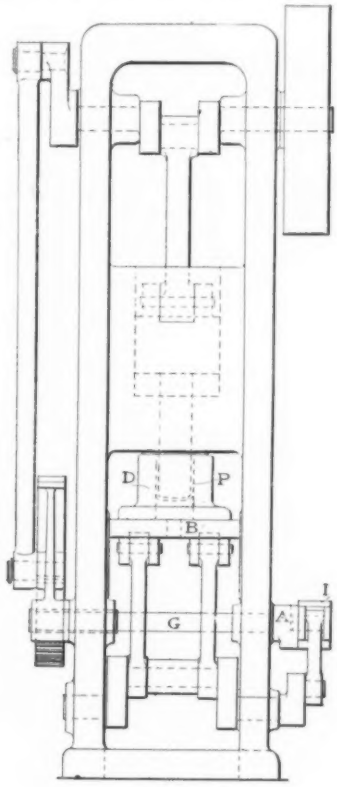


FIG. 2

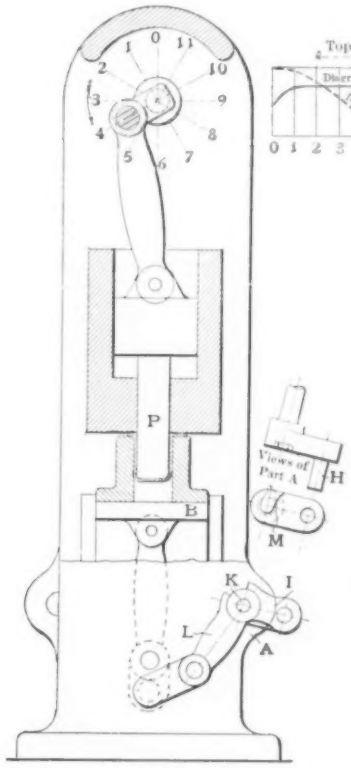


FIG. 3

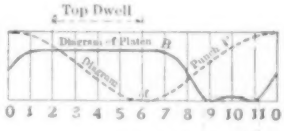


FIG. 4

American Machinist

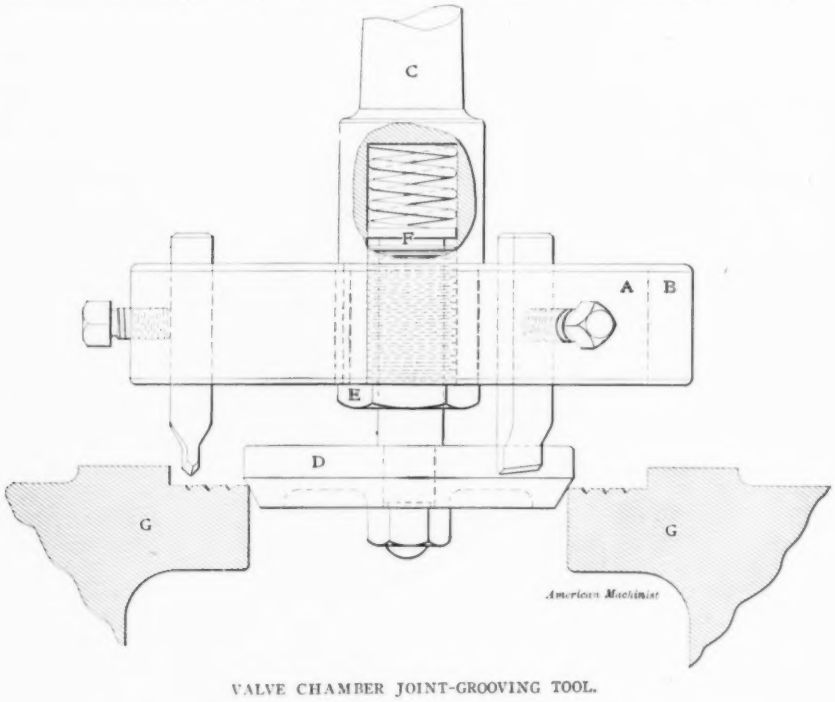
DRAWING PRESS MOVEMENT.

mounted in position for milling the hand hole faces, a milling head being shown above hand hole face. A key is let into *A* near the lower edge against which the work rests, and a machine steel lug (not shown) enters *A* near its top edge, thru which is a set screw, forcing and keeping work against the key. Slots thru *A* are provided for clamping the work. *B* is made with a tongue to suit the machine platen, and is held to the machine by clamping. Several different lengths of tie bars *C* were made to suit the different angles of work that we had to do, and the change from one angle to another consumed but a few minutes. We could always rely upon this fixture. The different tie bars were marked the different angles.

BECK.

Grooving Tool for Pump-Valve Chamber Joints.

Some trouble was experienced in making the grooves in the pump-valve chamber joints. We produced a tool, as per sketch, that filled all the requirements. *A* is a gray-iron casting having three openings for the admission of the groove tools, the tools being 120 degrees from each other, and cut to necessary depth for each tool, the outer and inner tools being shown. *B* is a mild steel band shrunk upon *A*, thru which are the set screws holding the tools. *C* is a tool steel shank (No. 4 Morse taper), and is cut away to show pilot stem actuating the spring. *B* is a



VALVE CHAMBER JOINT-GROOVING TOOL.

tool steel pilot, hardened and ground to 60 degres. *E* is a bronze threaded sleeve, made long enough to hold the pilot stem *F* and pilot steady while the three grooves are being made. Underneath the spring and on the flange of the pilot stem *F* is a hardened tool steel washer, the pilot stem *F* being also hardened and ground. On starting to groove a packing seat, the first part of the tool to touch the work is the pilot *D*, centering the tool to the work as shown, the tools being placed so as to allow quite a compression upon spring before tools will touch the work. Before the tools touch the work the friction upon the angles of *D* has become so great as to cause *D* and *F* to remain stationary while the tool head turns upon the stem *F*. The sketch shows the completed packing grooves, and the head being withdrawn from the work, the pilot *D* retaining its position until the flange on the pilot stem *F* has come to rest upon the upper end of the bronze sleeve *E*.

Self-hardening steel is used for tools. A section of the pump valve chamber is shown at *G*.

BECK.

Rig for Facing Pulley Hubs to Length.

Having a large quantity of pulleys to bore and turn and face the hub to an exact length, we made the rig shown in the accompanying sketches for facing the hubs on an engine lathe. It has been a great time-saver, and for accuracy it leaves nothing to be desired.

The pulleys, 9¾ inches diameter, 1¼-inch bore and 3½ inches long thru the hub, were first bored and faced on one side, and turned in a turret lathe, leaving the opposite side of the hub to be faced dead true with the first side. This we did at the rate of twenty per hour, with boy labor, in the following manner: *A* is the pulley to be faced; it fits on the cutter bar *B*, which takes the place of the live center in the headstock, being tapped out at the back end, and drawn tight up by a ⅝-inch bolt passing thru the hollow spindle. *C* is a flat facing cutter, held in the bar by a wedge, as shown. The end of the bar which fits the pulley—a nice running fit—has four flutes cut in, as shown in Fig. 4, to collect the dust and dirt which may be in the bore. *D* is a threaded bar which carries two lock nuts, and the bent arm *E*, as shown in Fig. 2. This takes the place of the center in the tailstock, as shown in Figs. 1 and 2. The

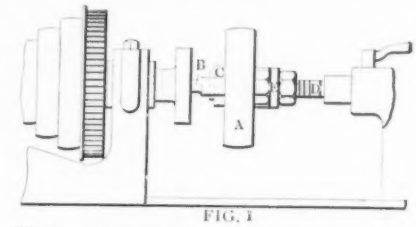


FIG. 1

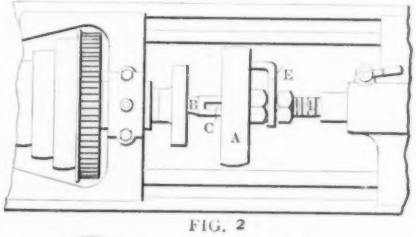


FIG. 2

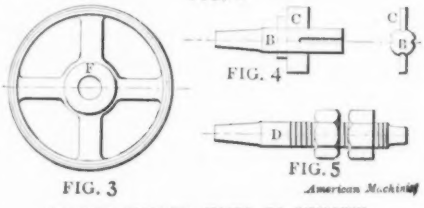


FIG. 3 FIG. 4 FIG. 5

FACING PULLEY HUBS TO LENGTH.

pulley is shown at Fig. 3. *F* being the hub to be faced, it is placed on the bar *B* while running. The tail spindle carrying *D* is then run up, forcing the pulley hub against the cutter *C*, the arm *E* preventing the pulley from rotating by holding against one of the arms. *D* is forced up until its reduced hardened end meets the end of *B*, also hardened. The hub is then faced to the exact width required. The lock nuts having been adjusted to the required distance from the end, it is not necessary to stop the lathe at all when once started.

GUIDE PULLEY.

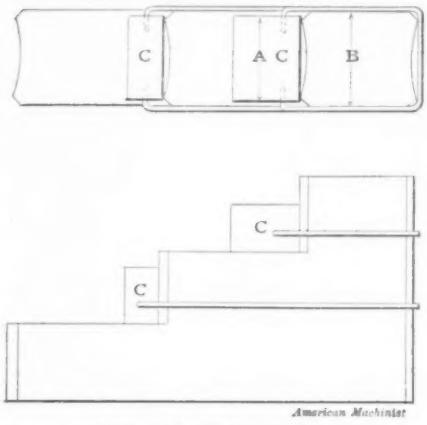
England.

Stop for Chuck Jaws.

The sketch shows a stop for use on chuck jaws to assist in setting a piece of work parallel with the face-plate. Very often it takes a lot of driving back and forth to accomplish this result without the stops.

The blocks *C* (two sizes of which are shown in the sketch) are made in whatever sizes the work demands. They are made about 1-32 inch shorter than the width of the jaw, as shown considerably exaggerated at *A* and *B*. This is to allow the spring which encircles the jaw to press against the sides of the jaw before the bent ends come in contact with the ends of the block. The holes in the ends of the blocks are made an equal distance from two sides of the block in all cases so that all springs and blocks will be

interchangeable and allow each block to be used for two sizes by giving it a quarter turn. The holes must be drilled deep enough so that the springs cannot bottom. The springs require but little tension, but should be closely fitted to the jaws and blocks to prevent rattling.



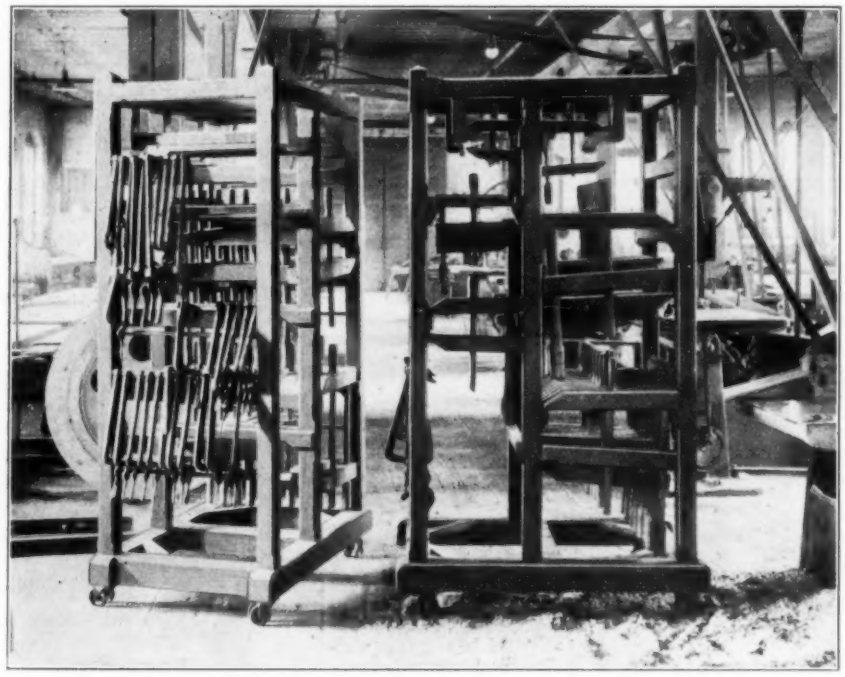
STOP FOR CHUCK JAWS.

One set of springs (not shown in the sketch) should be made to fit the blocks and encircle the whole jaw. This enables the blocks to be used either on the steps or the straight end of the jaw.

M. H. BALL.

Portable Rack for Hand Clamps.

The photo shows a novel portable clamp rack, which has several good points. It effectually gets rid of the objectionable practise of having clamps hanging from every available post or window frame throughout the pattern shop. Being mounted upon casters, it can be rolled to any part of the shop when considerable gluing is being done, and when removing clamps from work they can be at once placed on the rack. The position of the jaws, whether open much or little, making no difference. The central portion of the rack is designed to receive various sizes of wood clamps, while each end is provided with rods or bars to which the iron clamps are hung.

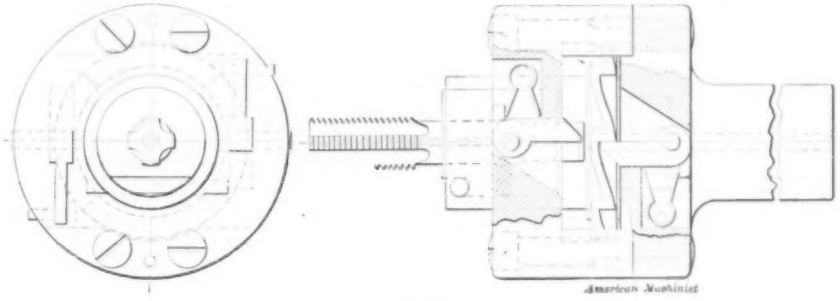


PORTABLE RACKS FOR HAND CLAMPS.

MACK.

A "Good" Tap Holder.

This title is used advisedly, as anyone who has ever struggled with the type of holder frequently furnished with equipment of automatic machinery will see by glancing at the accompanying drawing. The distinctively bad features about the ordinary type are: Small diameter of the shank, which makes oil feed impracticable and leaves the wall of the shank too thin, making it impossible to grip it very hard in the turret; releasing impossible in the case of pipe tapping. The size is also a consideration, especially when applied on certain classes of turrets.



TAP HOLDER.

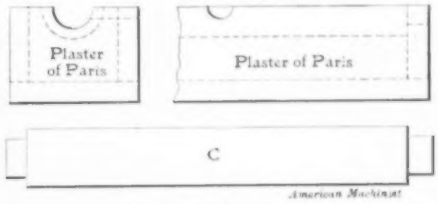
By referring to the drawing, it will be seen that this tap holder has provision for oil supply thru the shank; it has as powerful a release as it has drive; it does not throw oil when reversing at high speed. I have been using one for three months steadily on a 2-inch Cleveland automatic turret machine and am still using the same tap. The holder is in as good condition as when first put in.

Should this illustration strike anyone as being O. K., I shall derive considerable pleasure from giving all information asked for.

PLODDER.

Casting Lead Laps.

The sketch shows a mold for casting lead laps. It is simply a wooden box to be filled with plaster of paris, and *C* is an arbor for pressing into the plaster to form the mold for the size of lap required. The ends of the box are cut out to a ¾-inch semicircle and a groove is cut in the middle of one side for pouring. The box is filled with plaster of paris, and while this is still soft the arbor is pressed into it and with the arbor in the mold the plaster is allowed to set. Then the arbor is taken out and the other half of the mold is made in the same way. The iron core upon which this lap is to be cast has numerous holes drilled part way into it to hold the lead firmly. The core is laid in its place and the halves of the mold are clamped together. The hole for pouring the lead should be on the center line, allowing the mold to be easily taken apart after the lap is cast. This mold can be used for casting many laps, and it requires but a small allowance for turning.



CASTING LEAD LAPS.

LAPLAND.

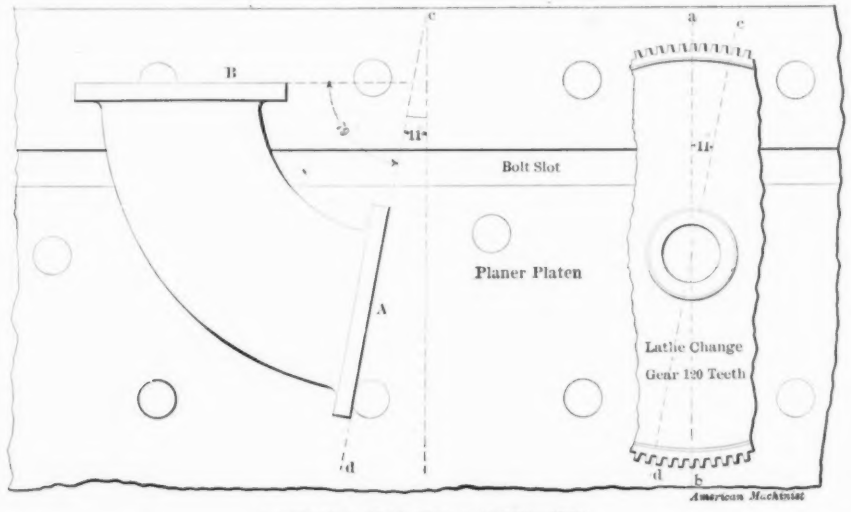
Liquid Chalk.

A very handy thing to have on the bench where there is much work to lay out on castings or sheet iron, is a solution made of chalk, glue and water. I take a pint can and powder enough chalk to fill it two-thirds full, then fill it almost full of clean hot water and add about two tablespoonfuls of liquid glue and mix thoroughly while it is hot. This is much more handy than chalk, as you can put it on

with a brush the same as paint. It will not rub off in handling and gives a nice surface to work on. The chalk must be powdered very fine or it will be rough when dry. H. S. GILLETT.

A Change Gear for a Protractor.

The omission of some construction lines and dimensions on a blueprint of three gray-iron elbows to be planed led me to find a simple means of laying out the required angles by the use of a change gear from one of the lathes. This was in a shop where nobody had a protractor and where no man would bring in any expensive tools thru fear of losing them. The best gear to use for this purpose would of course be one of 360 teeth, but in this case a gear with 120 teeth was used. The angles to which the elbows were to be planed were 75, 79 and 85 degrees, the complements of these angles being respectively 15, 11 and 5 degrees. The sketch shows the 79-degree elbow. The flanges were planed vertically, and when one flange *A* had been planed then came the job of setting for the angle required to plane flange *B*. A place across the planer platen was cleaned and chalked and the line *a b* was drawn across it with a square. Then the 120-tooth gear was laid down on this so that the centers of opposite teeth coincided with the line, as shown. From the center of one tooth to the center of the next is of course 3 degrees. Then taking three teeth and two-thirds of the space to the center of the next tooth gives us 11 degrees, and when the line *c d* is drawn we have all that is required for setting the elbow. At the left in the sketch the elbow is shown with the planed flange *A* coinciding with this line and the



A CHANGE GEAR FOR A PROTRACTOR.

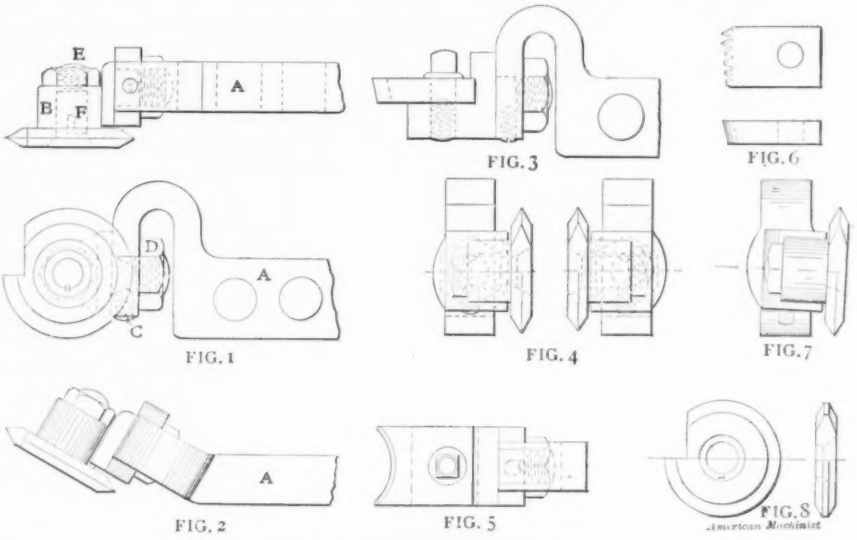
flange *B* in the correct position for planing. It of course is not necessary to show the straps and bolts and stakes required to hold the elbow. For the 85-degree elbow one tooth and two-thirds was taken and for the 75-degree elbow the angle was just five teeth of the gear.

D. WINKEL.

An Interchangeable Spring Tool.

As I have noticed from time to time different ideas on spring thread tools, I am sending drawings of the one I am using. The idea is not new by any means, but is a little different in design than any I have seen, and by a few extra parts quite a variety of tools can be used with it. The body of the tool *A* is made of tool steel ½x1 inch, with the "goose neck" at the forward end, as will be seen in Fig. 1. The neck comes straight down and is flattened out to about ¾ inch wide; part *B* is also of tool steel. The stub on the end is about ⅜ inch diameter, with a slight groove cut in to receive the screw *C*, Fig. 1. This screw holds part *B* from sliding out when nut *D* is loosened; this is made so for ofttimes it is necessary to cut up to a shoulder on either side, so by slacking of *D* part *B* can be turned over so the cutter will be on the opposite side. There can be two cutters, or having two cutting edges on the same cutter will do as well. The cutters are held in place by the taper head screw *E* having a key at *F* to keep from turning. The holes in body *A* are for no use only to make the tool as light as possible. Fig. 2 shows the same tool, only offset.

Fig. 4 shows the cutters changed to cut to a shoulder on the right or left side. Fig. 5 shows another attachment that is used for form cutters and also thread chasers as in Fig. 6. Fig. 8 shows the circular cutter that is used with a taper hole and keyway to receive the screw *E* and key *F*. AXEL NORDSTROM.



AN INTERCHANGEABLE SPRING TOOL.

In a suburb in New York city a priest of one of the churches announced that a collection would be taken up to defray the cost of coal for heating the church. Nearly everyone in the parish contributed except one Muldoon.

A day or so thereafter, the priest, happening to meet Muldoon, said:

"Dennis, why didn't you give something toward the coal bill?"

Whereupon Dennis gave his reverence a sly wink.

"Come, come, father!" he said. "The idea of ye thrying to make us believe the money is wanted to buy coal for the church, whin I, as well as your riverence, knows that it's heated by steam!"—*Harper's Weekly.*

At Torquay, England, five "Chelmsford" steam omnibuses have been run experimentally for a year and a half, and now three more of the same type have been ordered. The company is the pioneer in this line, and is the first to pay a dividend of 7½ per cent. after running twelve months.

The largest raindrops are about one-fifth of an inch in diameter. To determine the size rain is allowed to fall into a thick layer of flour, each drop forming a pellet of dough, and these pellets are compared with dough pellets obtained from drops of known size delivered upon the flour by artificial means.

Another Prize Emery Wheel Guard.

At page 268 we showed the emery wheel guard of E. Thomé fils et M. Mairesse, which has received an award in the international competition opened by the Association of Industrials of France against Accidents of Work. Since the publication there has come to hand a more extended and precise account of the matter, as contained in an article of Henri Mamy, director of the association, printed in the *Génie Civil.* It appears that no first prize was awarded, but that the 1,000 francs was divided as follows: 400 francs each as second prizes, to the Société Naxos-Union and Thomé fils et Mairesse; 200 francs, as a third prize, being given to Mayer & Schmidt, while MM. Denis Poulot, Richard, Verdier & Cie. received honorable mention.

The Naxos-Union guard consists of a chain which surrounds the wheel, except that part where the work is to be done. The intervals between the pins of the chain are filled by a thin, flexible, iron band, which is woven thru them, passing alternately over and under. To the stand are fixed supports *d*, which hold rings *c*, capable of being rotated to different positions. Each ring carries a fixed arm *e*, to which one end of the chain is bolted. It is also bolted to the oscillating arms *b*. The bolts, which are screwed down more or less tightly, are set in grooves, which not only give them a chance to yield a little if fragments of the wheel are hurled against the chain at such place as to occasion it, but permit the adjustment of the chain to allow for the wear of the wheel. When a rupture takes place, the chain is driven in the direction of rotation, and the oscillation of the arms tends to close the envelope and reduce the opening for the escape of the pieces.

The Société Naxos-Union offered a second arrangement, also, which it was impossible for the examining committee to consider as a contestant, since it required a special form of grinding stand, which was contrary to one of the conditions of the competition. Yet it has been subjected to practical tests, behaves well, and is interesting to notice (see Figs. 4, 5 and 6). Its characteristic feature is automatic release when the wheel bursts. On the frame is mounted the usual shaft, which carries the wheel and is driven by the loose pulley *c*, with clutch. The guard is formed of a strong band *e*, consisting of several segments with overlapping ends. As the wheel wears away, the band is taken up by lengthening the laps. One end is coiled around the bolt *f*, to which the last coil is riveted. If the wheel breaks, the band, driven around by the fragments, will extend, by unwrapping this coil, so as to close the opening left for grinding purposes. The band carries several shoes *j*, as shown in Fig. 9, so that if a fragment flies it will take hold and close the guard in this manner. The way in which the band is held by arms and rings is, in

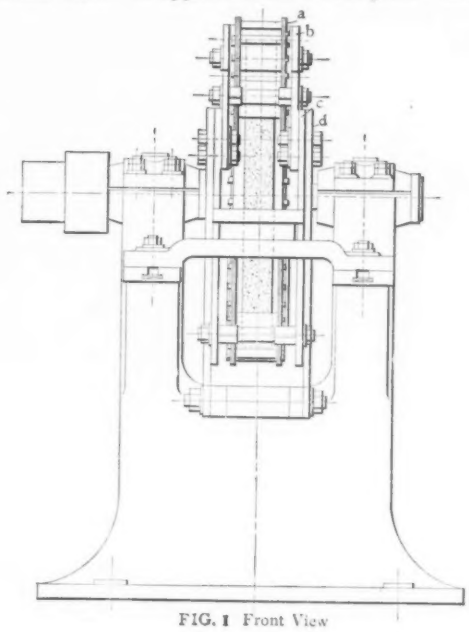


FIG. 1 Front View

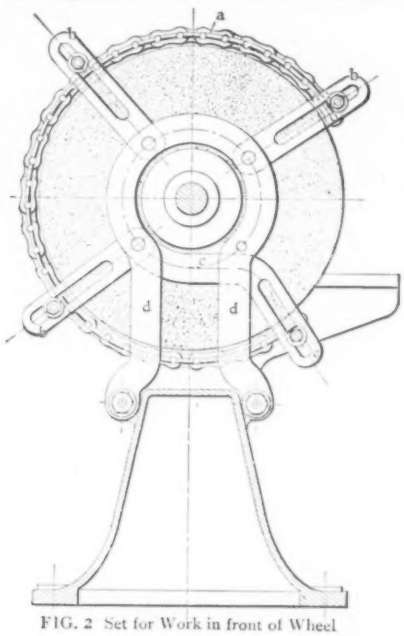


FIG. 2 Set for Work in front of Wheel

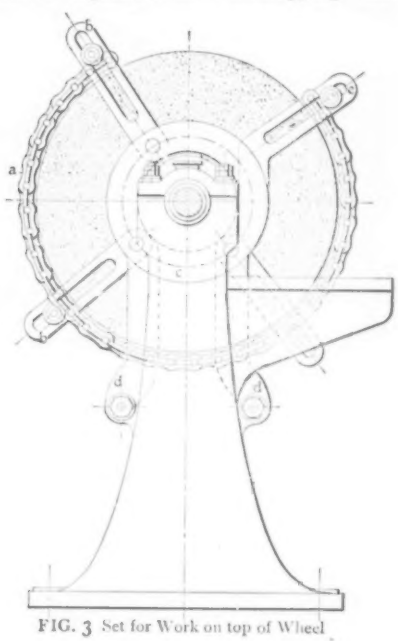


FIG. 3 Set for Work on top of Wheel

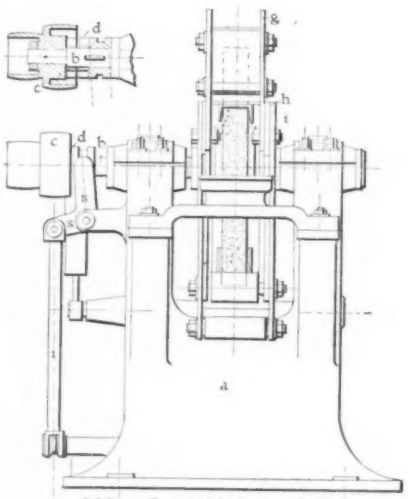


FIG. 4 Guard with Automatic Release Front View

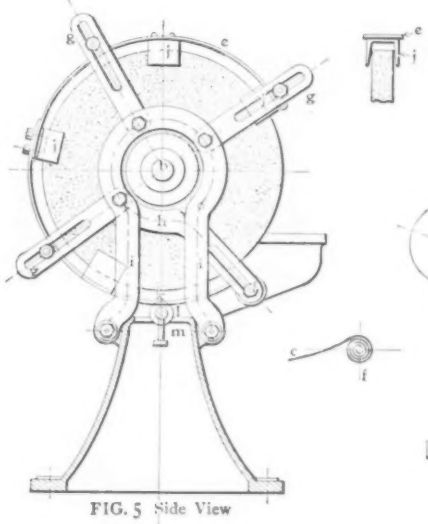


FIG. 5 Side View

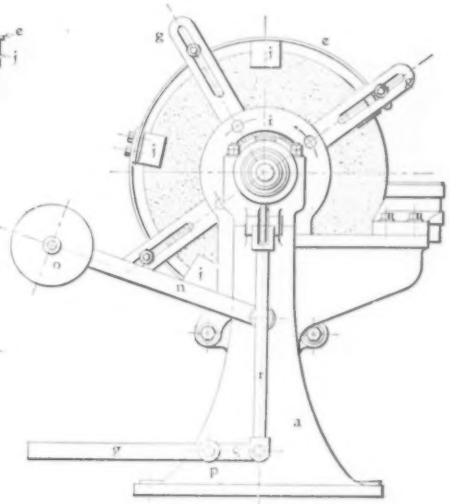


FIG. 6 Releasing Device

American Machinist

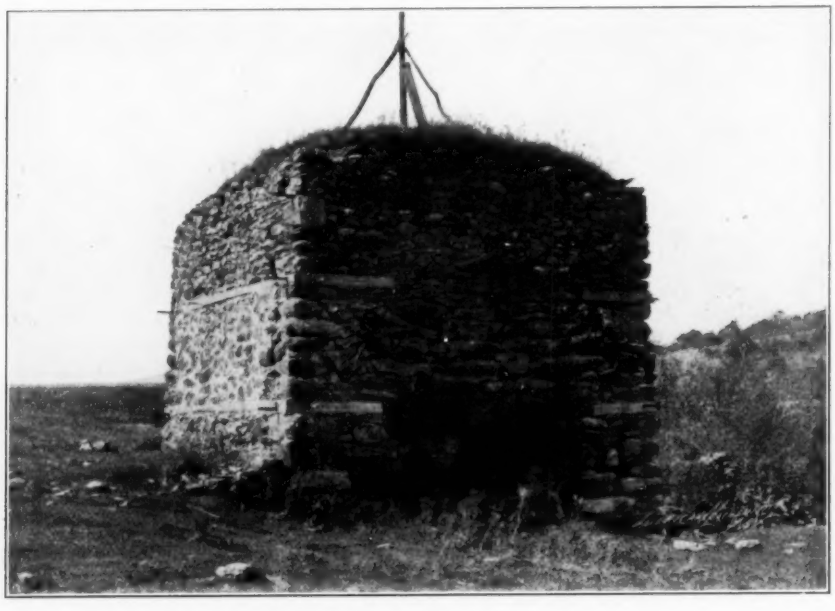
general, similar to that heretofore described.

If the wheel bursts the machine is uncoupled as follows: The band *e* carries a little release bolt *k*, against which rests a rod *m* passing thru a shaft *l*. At the end of this shaft is an arm *n* carrying a weight *o*. Below this weight a lever *q*, hinged on a bolt *p*, is connected by the rod *r* to a bellcrank *s*. The upper arm of this crank acts on the clutch. When the wheel bursts and the band is moved, even a very little, the bolt *k* leaves its place. The rod *m* being no longer held, the arm *n* and its weight *o* fall on the lever *q*, which acts on the crank *s* and releases the clutch and stops the rotation of the shaft.

An Old New England Blast Furnace.

BY O. S. PIKE.

Among the interesting objects of the lower Berkshire Hills are the old blast furnaces and forges.



AN OLD NEW ENGLAND BLAST FURNACE.

The half-tone shows an abandoned furnace on Mount Riga, Salisbury, Conn. In the background can be seen a portion of the dam which holds back "Forge Pond." The furnace is about 20 feet high and 20 feet square. Its date of completion was 1810. The blower house, charging arrangements, etc., have disappeared. The condition of the masonry makes it difficult to tell how the tweers were led into the interior. The iron bars projecting from the corners suggest stagings. A flagstaff now surmounts the furnace.

It is not clear why the furnace was built at so inaccessible a spot. Ore was hauled from the mine at Ore Hill, more than two miles distant, over a rough road rising 800 feet in two miles. The hill is extremely steep in places. It is possible that the available water power influenced the location.

Heaps of slag, scattered foundation stones, and cellars of houses now out of existence, are mute witnesses of a once flourishing industry.

A Plea for the Rule of Three.

The perennial product of the scientific classes in this country probably reaches into the thousands. Compared, then, with the scheme of education which existed fifty years ago and gave birth annually to, at most, a few dozens of highly trained mathematicians, it must appear somewhat strange that so much could be accomplished in the direction of original engineering work by a race so unscientific as our forefathers now are regarded by many of their professional posterity.

Whence came the knowledge which produced the Howe truss? Where did Jervis find the education upon which to build the Erie Canal? By what formulas were calculated the stresses in the Starrucca Viaduct or the High Bridge over the Harlem River? Howe was a country carpenter with the practical instincts of a contractor. Jervis was a farmer's son, whose first engineering work consisted in driving stakes. Nevertheless, these men had a good working knowledge of mathematics; the monuments left by them prove it, and in the nature of things they must have had it. Their books were few: Gillespie's "Surveying," "Euclid" or "Davies' Legendre," and a little, a very little, algebra. But they were giants in accomplishment, and one reason was, that to them mathematics was a means and not an end. A correct approximation had more value than the most abstruse calculation, and no sanctity attached to the seventh place in decimals.

With the large influx of specially trained mathematicians who now annually enter the field of active work, there has crept into technical literature a tendency toward the hair splitting of terms which aims at profundity but more often reaches the absurd, and tempts the practical reader to a profane condemnation of all abstractions. Not much of this finds expression in the technical press because of the merciless blue pencil, but the proceedings of technical societies bristle with it in the least expected places. A recent and characteristic instance appeared in the bulletin of a local engineering club where the author attempted to frame an equation for predetermining the strength of a T-rail. He integrated; he differentiated; he eliminated and substituted; and finally, after several pages of mathematical cackle, proudly laid a sterilized egg in language somewhat as follows: "We have here figured the strain for a steady load. . . . The real effect is impossible to figure out, but the velocity of the train does undoubtedly lessen the strength of the rail."

Unfortunately, this is not a rare case; it is, in fact, almost typical of a large class of papers, which, unconsciously perhaps, adopt the archaic and rarely necessary method of "reductio ad absurdum" to prove that the subject of discussion has no real existence. Much of this tendency is due to educational methods which mistake the form for the substance, the means for the end, the plans for the structure itself. There are splendid exceptions and a modern instance lies before us wherein the author of a new textbook on bridge design—Professor Burr—restricts the requirements of the student to "some knowledge of elementary algebraic methods, including the method of moments or sections . . . but nothing more." Compare this simplicity and directness with the unpractical wish of a certain professor who wanted the course in descriptive geometry to be extended thru the whole college period of four years!

We have said that mathematics are a means and not an end, and the truth of this glows when we stop to consider the source and advance of physical knowledge. What is simpler than the manifestations of the lever, of gravitation, of friction? Yet many a student has been confounded upon first studying them thru the medium of an instructor who regards an equation with a factor of the *n*th power as the substance instead of a shadow. The truth of the polarization of light is no more difficult to realize theoretically than the angle made by a billiard ball in striking and leaving a cushion; but we have seen a professor ignominiously break down before a class in attempting to demonstrate it by means of a quadratic.

A highly accomplished engineer once said that his success was due, one-half to common sense and one-half to the rule-of-three, and altho this must be taken with a grain of salt, it is expressive of the really broad professional mind which

wastes little effort and follows, as nearly as they may be seen, the lines of least resistance. For younger men, such a statement contains a moral worth regarding, since it is from among the minds of the same quality whence the heads of the profession select their chief assistants. And, if a further proof be needed, read the discussions in the technical proceedings of societies, where it will be seen that the reputations of the men who take part are almost in inverse value to the amount of space given to intricate mathematical demonstration.—*Railway Age.*

Sale of the Fitchburg Machine Works.

It is announced that Marcus A. Coolidge, the well-known street railway contractor, has become the owner of the Fitchburg Machine Works, Fitchburg, Mass. The stock has been held for the past twenty years or more by female heirs of Harrington Sibley and Joseph Wilson, who have not been personally competent to conduct the business, and it has not kept pace with the times. The works were organized in 1867 by Harrington Sibley and some local capitalists. They manufactured lathes, planers and other tools of high-grade for the time, and grew and prospered, being incorporated later with a capital of $60,000. A change was made in the management of the company a short time ago, and its business was considered to be improving, and the sale of the works is more or less of a surprise to those familiar with their history. It is announced that Mr. Coolidge will devote all his time to the business. There are at present fifty men employed, which number will be increased. The company will continue to make a specialty of machine tools.

Prominent Mechanics in a New Twist Drill Concern.

The following item, published in a New Bedford, Mass., paper, relates to the doings of men who are well known in tool and machine circles, and announces the formation of a company which will have as its managers men of well-recognized ability and high standing. The article referred to is as follows:

Four of the employees of the Morse Twist Drill & Machine Company, including Superintendent John A. McGregor, have resigned their positions with that corporation, and associated with others have organized a rival concern to be located in Athol.

The new company is capitalized at $600,000, and is to be known as the Union Twist Drill Company. It is incorporated under the laws of Maine. Mr. McGregor will be the president and Edgar T. Ward, of Boston, the treasurer.

The men who have left the Twist Drill with Mr. McGregor are John W. Boynton, a mechanical engineer; Simon Mackay, foreman; and W. B. McSkimmon, superintendent's clerk. These have associated themselves with J. Henry Drury, for twenty-nine years of the sales department of the Brown & Sharpe Company, of Providence, with which Mr. McGregor was connected before he came to New Bedford as superintendent of the Twist Drill. Mr. Ward, the treasurer of the new concern, is a member of the Gay & Ward Company, which has been located at Athol for some time and which has made a specialty of cutters. The new company, the Union Twist Drill Company, has purchased the plant of the Gay & Ward Company and will spend a large sum of money in enlarging and improving it.

L. S. Starrett, of Athol, Mass., is a large stockholder in the new company.

Examinations for Cadets in the Revenue Cutter Service.

The United States Civil Service Commission announces examinations to be held in designated cities in the several States, May 17, 18, 19, to secure eligibles from which to make certification to fill existing vacancies in the position of cadet in the revenue-cutter service, and other similar vacancies as they may occur. Cadets, when appointed, must be not less than eighteen nor more than twenty-five, not less than 5 feet 3 inches, physically sound and unmarried. Applications for information and blank applications should be made to the United States Civil Service Commission, Washington, D. C. There must be correspondence before the dates given to arrange for the examinations at the points most convenient.

Meeting of the Industrial Economic Department of the National Civic Federation.

The above-named section of the Civic Federation held its first meeting Tuesday evening, April 25, at the close of a dinner at the Park Avenue Hotel, New York. August Belmont, president of the Federation, presided and announced the subject for discussion, which was, "How Far Does Associated Effort in Industries Interfere with Individual Liberty?" The speakers were President Eliot, of Harvard University; Professor Seligman, of Columbia University; Frank Foster, of the Typographical Union; Louis D. Brandeis, and Samuel Gompers president of the American Federation of Labor. A paper by Francis Robbins, who was unable to attend, was read by the secretary.

President Eliot began his address by stating that the real foundation of American progress was the efficiency of the American at work, and attributed this largely to American freedom and ambition of the individual. In regard to organization, he said that trades unions and employers' associations were natural products of a democracy; hence would endure, but "both should give over the pursuit of monopoly, recognize that competition is essential to progress, and see in liberty for the individual the mainspring of efficiency."

Mr. Gompers, the last speaker, said that the workman's protection was organization, and that workmen now deriving the benefit of shorter hours, higher wages, etc., would hardly agree that they had been deprived of their liberty by organization. He spoke of the recent decision of the Supreme Court of the United States in holding unconstitutional the ten-hour day for bakers, and said there was a possibility of the bakers being expected by their employers to go back to the longer working hours of years ago.

Monthly Meeting of the A. S. M. E.

The last of the season's monthly meetings in New York of the American Society of Mechanical Engineers was held at the Society House, April 25. Gus C. Henning discoursed upon diamonds, diamond cutting and diamond cutters. President Freeman, as usual, introduced the speaker in his happy, epigrammatic way, this time alluding to the visit of the American Engineers to England and their visit while there to the diamond-cutting establishment of a grandson of Sir Henry Bessemer. The meeting was a "ladies' night," and many ladies were present and occupied seats in the auditorium.

Our American consul-general, Richard Guenther, of Frankfort, Germany, reports the importation into Austria of several thousand barrels of American alcohol, and speaks of the consternation produced by this importation in certain circles interested in the alcohol trade. We presume this means that the situation with regard to the internal revenue tax on alcohol is such that American producers of alcohol can send it abroad to be used in industries there, competing more or less with American industries, and to supply it at prices which are probably about one-fourth what similar alcohol costs an American manufacturer who needs to use it.

We are informed that there is to be held during the Universal International Exhibition at Liege, Belgium, the Second International Petroleum Congress, which is to be held under the patronage of the Belgian Government and the discussions will be devoted to things connected with the production and utilization of petroleum and its various products. Full information can be obtained regarding this matter by addressing M. Fernand Petit, general secretary, 95 Chaussee de Wavre, Brussels.

The George W. Pierce Company, of Buffalo, N. Y., offers prizes aggregating $1,000 for the best design of body for an enclosed automobile and for the best color scheme for any automobile.

AMERICAN MACHINIST

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What Shall We Do About Our Foreign Machinery Trade?

Most American machinery builders who have been abroad to study the business situation and to ascertain the conditions under which we must do business with foreign customers are agreed that we need and for some time have needed to recognize conditions as they exist and if possible to modify our tariff laws, either directly or by reciprocity treaties. Particularly has this been perceived to be true with respect to our trade relations with Germany.

Entirely without regard to previous ideas on these matters based upon political affiliations American machinery builders who have gone abroad and talked business with machinery buyers and users have been brought to see the essential absurdity of the position we take. We in effect say to foreign buyers of machinery, "We want to sell to you our machinery, but none of your machinery will be allowed to land on our shores," and "Our machinery is so much superior to that you make for yourselves that, if you buy ours, the things you will produce by it will be much cheaper than the things you are now able to produce. But this same machinery used in our own shops at home does not enable us to produce low cost things. Indeed, the cost of what we produce with it at home in our own shops is so high that we have to be protected against the importation of your cheaper and better machinery by a duty of 45 per cent."

Stated in this way the absurdity of our position is at once apparent. It is a form of statement which an American traveling abroad frequently has presented to him by foreigners, and it cannot be said to be very much if at all erroneous.

The fact is that we ought to choose and squarely announce what we purpose to do. If we here in America choose to do so, we can undoubtedly get along pretty well without either importing or exporting goods of any kind to any great extent. Our territory is so large, our climate and soil so varied, our mineral wealth so great and the wisdom of our forefathers, in placing in our Federal Constitution a prohibition of tariffs between States of the Union, so profound, that we could get along if we had to or chose to with those things which we could ourselves produce, and this would be at least a logical position for us to take regardless of its wisdom or unwisdom.

On the other hand, we may decide, as we seem to have decided, that we wish to sell some of our products abroad. If we sell them abroad it is clear that we must allow our foreign customers to pay for them in something which they produce. It is true that a considerable share of our exports are paid for by claims against us, held by foreigners who are owners of American railway shares or bonds, or owners of mortgages or of American real estate, but as the dividends, interest and rents which we must send abroad on this account are not equal to the entire value of all we wish to export, something produced by foreigners must be accepted here in payment for the balance of our exports—something produced by foreign labor and capital. To say that we will not allow any such things to come to our shores in payment is inconsistent and to say, as one of our prominent machinery merchants did some time ago, that "we must preserve our home market for ourselves and at the same time develop and extend our foreign markets" is ridiculous and absurd. We may choose which way we shall go, but we cannot go both ways at the same time.

This elementary fact is fully recognized by Fred. Geier, of Cincinnati, who wrote the report of the committee on reciprocity at the recent meeting of the Machine Tool Builders' Association, and it formed the basic idea of most of the letters we published in 1902, in which letters the machine tool builders of the country set forth with practical unanimity their views to the effect that so far as the machine tool trade is concerned, the protective tariff is of no use or benefit and is only an impediment to foreign trade.

All this is again brought up by the proposed action of Germany, by which American manufacturers are to be placed at a still greater disadvantage in respect to German trade. That the new ideas are gaining headway has been shown in many ways, and most recently by an article published in the *Tribune*, of New York, which is to the effect that the present tariff schedules must soon be changed. Such a declaration, if it came from a different source, might be less significant, but the *Tribune* has been in the habit of maintaining that the present tariff is perfect and inviolable. Most machinery builders have long thought that it could be improved, and no doubt they will be glad to note that the thought is spreading.

In the meantime, and before we can succeed in getting anything done to prevent it, our foreign machinery trade seems likely to be dealt a serious blow by the action of Germany, which action no American can consistently find fault with. For has not Germany repeatedly offered to trade with us on fair terms? But the refusal of our Senate to act upon reciprocity treaties has made it impossible.

We recommend to the careful attention of our readers Mr. Geier's paper, published at page 530, and especially the words of Mr. Schütte therein quoted, as follows:

"If the United States does not come to some arrangement with Germany, we shall simply have to pay the rates as specified above [44 cents to $1.28 per 100 pounds], which, as you can well imagine, would be a great hardship to us and is certainly bound to cut down purchases for Germany to a very large extent."

Mr. Geier has himself been much abroad,

and has been one of our largest exporters of machine tools to foreign countries. We do not know what his brand of politics is, and it doesn't make any difference. His summing up of the matter in the paper referred to will be recognized as the words of sober truth and earnestness and to be based upon business considerations, pure and simple. We quote from them as follows:

"The duty of our country in this crisis, which we manufacturers ought to recognize and use our influence to meet promptly, is to cease waging war against these nations with whom we desire to trade, and to enter upon some amicable treaties with them in which we shall give as good as we desire to take. We have long been at a point where it was evident that our country was not a sufficiently large field for the full expansion of our manufacturing enterprises. We want the world for our market, and we must enter that market by friendship and not by warfare. We cannot deal with Europe as we once did with Japan, compel them to open their markets to us, but we can offer to buy what they have to sell and thus persuade them in turn to deal with us."

Variable Versus Constant Speed Motors for Machine Tools.

Our readers can scarcely have failed to note the opposite tendencies of two lines of development in machine-tool driving which have been showing themselves for several years and have now become very distinct. We refer to the increased efforts by motor builders to provide satisfactory variable-speed motors of wide range and the effort of machine-tool designers to dispense with variable-speed motors altogether. Of the former we need not say much, as the motor builders see to it that our readers are kept informed regarding the progress made in perfecting the variable-speed motor, but with the extent of the latter movement one can become acquainted only by watching the development as it takes place. It began with the gear-box drive on the Bickford radial drill exhibited at the Pan-American Exposition and, without attempting to exhaust the list or to guarantee its chronological accuracy, we may name the Brown & Sharpe universal milling machine, the flat turret lathe, the Bullard boring mill, the Pratt & Whitney 16-inch lathe, the Brown & Sharpe vertical spindle milling machine and the Kearney & Trecker plain milling machine, as those on which a constant-speed motor with mechanical speed variation arranged for easy and quick manipulation has already been adopted to the exclusion of the variable-speed motor.

This movement is all the more striking from the fact that it was the variable-speed motor that demonstrated the advantage that lies in quick and easily operated speed change devices and to many the advantage of motor driving seems to consist chiefly in its provision of such speed changes.

We fancy that the line of cleavage between the two movements will soon become apparent if it has not done so already and that it will be determined by the size of the tool. The builder of small and medium size machine tools has, until recently, found the application of motors to entail a good deal of a burden because of the necessity for adapting machines made on a manufacturing basis to the divers requirements of motors of different makes and when to differences of mechanical dimensions differences in speed ranges were added the situation became intolerable from a manufacturing standpoint. The adoption of mechanical speed change gears eliminated much of this difficulty and when the effort was made it was found that such change gears could be designed which would provide substantially as good facilities for changing the speeds as those provided by the motor controller, while the same machine could be supplied almost without change for either belt or motor driving.

On large tools the situation is entirely different, as with them the weight of the driving gears of mechanical variators and their mountings is necessarily such as to defeat the attempt to secure handiness of manipulation which is so conspicuous in the gears of smaller machines and, on the other hand, the adapting of a design to a special motor is relatively, at least, a much less serious matter with large tools than with small ones. Not being a manufactured product, no serious interruption in factory routine is introduced by such changes in patterns of large tools as are necessary and with the motors detached, as they usually are for such tools, the changes are fewer and less serious.

Without attempting to draw a defined line between them, we expect eventually to see the use of variable-speed motors increase on large tools and decrease on small ones.

The Associated Veterans of the Delamater Iron Works.

When the AMERICAN MACHINIST was young, one of the leading machine shops of this city was the Delamater Iron Works located at the foot of West Thirteenth street. Of nearly every development in mechanical engineering during the latter half of the last century the Delamater works might have said "all of which I saw and a part of which I was," for an astonishing number of things mechanical had their origin and to a large extent their development at these works—the most famous being, of course, the engines and other machinery of Ericsson's "Monitor."

Those who were connected with the works during the stirring times of the Civil War and others who came later have formed a social organization under the name of the Associated Veterans of the Delamater Iron Works, the aim of which is to keep alive the memory of the days that are gone, and several meetings around the festal board have already been held. The association already numbers twenty-four members and has a number of eligibles on its list. The president is Alexander H. Miller, of Jersey City, N. J.

Standard Catalogs in England.

The Engineer, of London, takes up the subject of standard catalogs, gives its experience with attempts to handle catalogs, which of course it receives from all over the world, refers to the very great variety of sizes and styles, and proposes that the Engineering Standards Committee of England take up the matter and propose standard sizes and other standard features of trade catalogs. If the Engineering Standards Committee does take up this question we sincerely hope it will consider the standard catalog sizes which have already been adopted in America, and are quite generally adhered to. It would manifestly be a very great advantage in the already existing international trade, and that which is to develop in the future, to have all the catalogs printed in the English language and pertaining to machinery or the engineering trades conform to one scheme of standards.

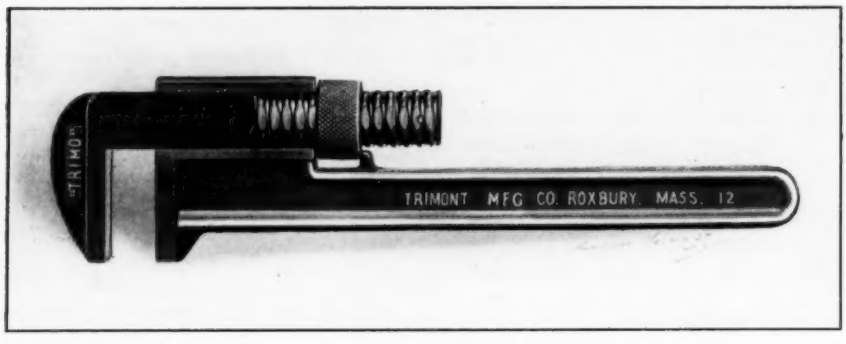
The Moline Tool Company, of Moline, Ill., sends us a proposition from the Pearl Oil Company, of Cleveland, Ohio, which is a new company, or at least a new name, but which seems to be unfortunate with its shipments of oil, as so many different Cleveland companies are. It has a small lot left over which it offers to the above-named company at what purports to be a low price. Tho the Pearl Oil Company is a new one to us, we note that it uses on its letter head the same engraving which is used by the Osborn Oil Company, and we might infer from that that the two companies are related. They at least have the same experience regarding shipments of oil. Or it may be that there are now so many companies in Cleveland sending oil to wrong places, or sending too much, or sending it to irresponsible parties, that the business of printing letter heads for them has become so extensive as to warrant commercial printers in going into that as a specialty, which might account for such points of similarity as we observe in the letter heads of these delectable institutions.

Reports from the Lewis & Clark Exposition are to the effect that the Machinery, Electricity and Transportation Building was finished some weeks ago, but owing to the unexpected demands for exhibit space in these departments, two annexes are now being built, each 100 feet square. The annexes will be finished within a week or so. Probably a large share of the machinery to be shown was exhibited at St. Louis.

New Tools and Machine Shop Appliances.

THE "TRIMO" WRENCH.

The half-tone shows a new monkey-wrench which claims for itself several points of advantage. Anyone can see how it works without explanation. It can be seen also that the leverage of the wrench increases instead of decreases with the size of the nut or bolt to which it is applied. There are but three pieces to it, all drop-forged steel and case-hardened. The back guide for the sliding jaw is integral with the front or body of the wrench, being connected to it by a central web which the sliding piece is slotted to straddle. The end of the slot is closed by a little block held in place by a cross pin, and the wrench cannot come apart until the pin is taken out. The screw thread is rounded top and bottom, and will not be easily mutilated if the wrench is thrown around. Made in three sizes by the Trimont Manufacturing Company, Roxbury, Mass.



THE TRIMO WRENCH.

GAS-ENGINE DRIVEN AND ELECTRIC-MOTOR DRIVEN, TWO-STAGE AIR COMPRESSORS.

The two half-tones show two different styles of air compressors recently built by the Laidlaw-Dunn-Gordon Company, of the International Steam Pump Company. Fig. 1 is a double-end, two-stage compressor, to be driven direct by a gas engine, the latter not being shown. The air cylinders are 21 and 12 inches in diameter and 12 inches stroke, giving, theoretically, a capacity of 810 cubic feet of free air per minute and delivering at a pressure of 100 pounds. A Crossley gas engine will be used at a normal speed of 170 revolutions per minute. The frame of the compressor has been designed to harmonize with that of the Crossley engine. The two air cylinders are not in line with each other, but are offset laterally so that each is operated by its own crank, and these cranks are made at 90 degrees to each other for the purpose of equalizing the torque upon the shaft. The engine flywheel goes on the shaft between the compressor bed and that of the gas engine.

Fig. 2 shows a two-stage compressor built for the General Electric Company to be driven by a 150 horse-power motor, the armature of which is on the middle of the crankshaft and between the two frames of the compressor. The air cylinders are 18 and 11 inches diameter and 24 inches stroke, and at 120 revolutions per minute the capacity, theoretical, of the machine will be 850 cubic feet of free air per minute, compressed to 100 pounds.

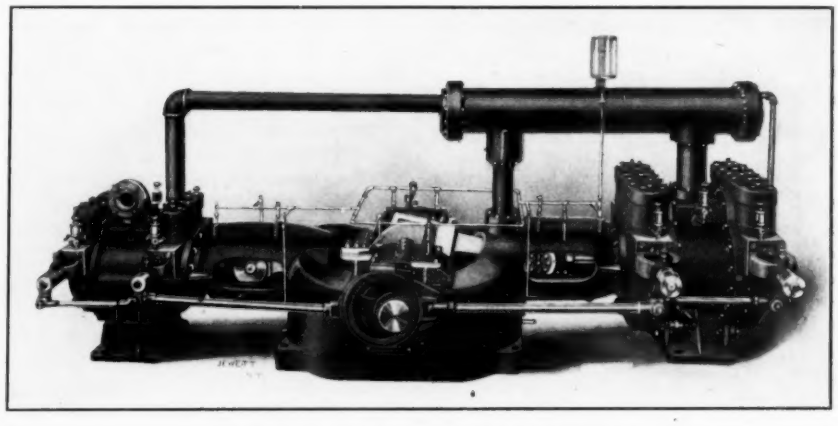


FIG. 1. GAS-ENGINE DRIVEN AIR COMPRESSORS.

Both of these machines have the Cincinnati valve gear by which the discharge valves are mechanically closed and both the opening and closing of the inlet valves are controlled. The operation of this system will be understood by reference to Fig. 3, a vertical section of one of the compressing cylinders. The piston is shown in midstroke and assumed to be

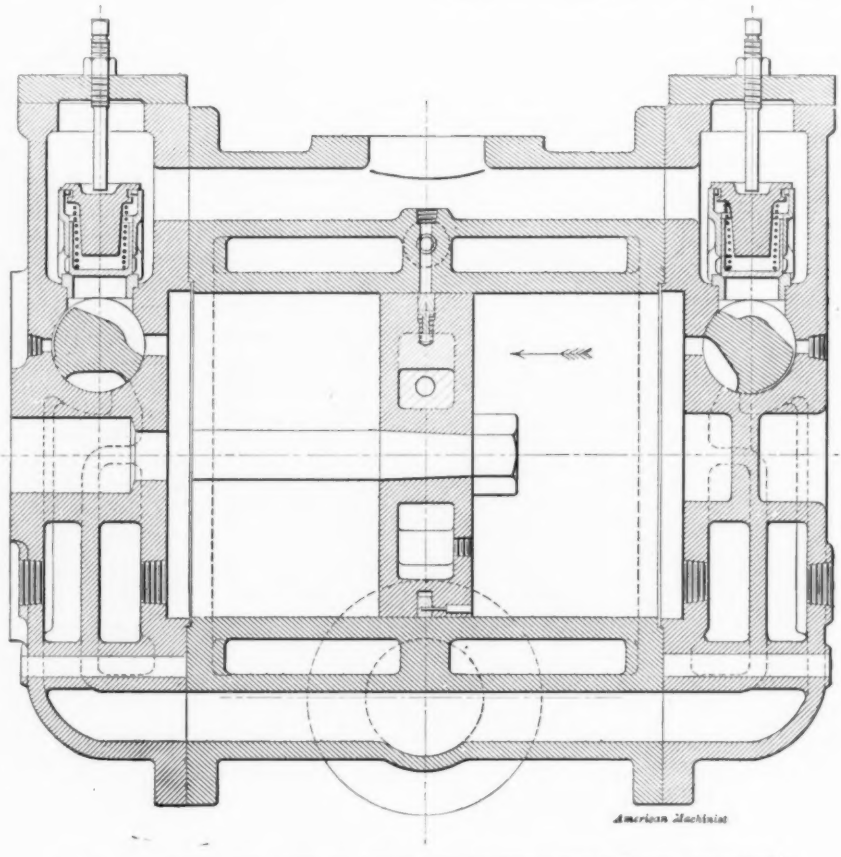


FIG. 3. SHOWING OPERATION OF VALVES ON INTERNATIONAL PUMP COMPANY'S COMPRESSOR.

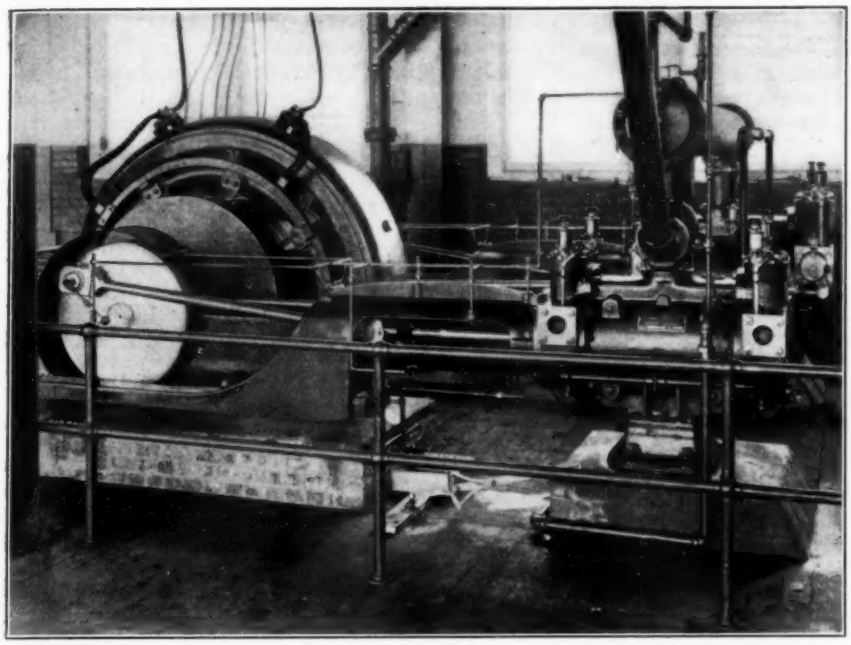
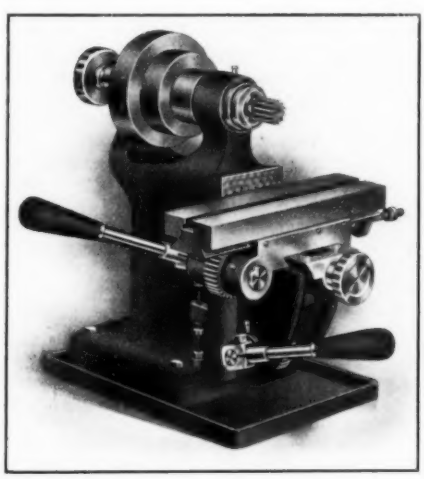


FIG. 2. DIRECT-MOTOR DRIVEN AIR COMPRESSOR.

moving to the left; the semi-rotary valves being in their correct operative positions. As soon as the air pressure in advance of the piston rises to the delivery pressure the left-hand poppet valve will rise and remain open until the end of the stroke, when the semi-rotary valve at that end promptly shuts off the discharge opening, allowing the poppet valve to seat quickly and easily. The right-hand semi-rotary closes the inlet opening at the same time.

A BENCH MILLING MACHINE.

The illustration shows a miller designed to meet the demand for a machine suitable for rapid, accurate manufacturing.



A BENCH MILLING MACHINE.

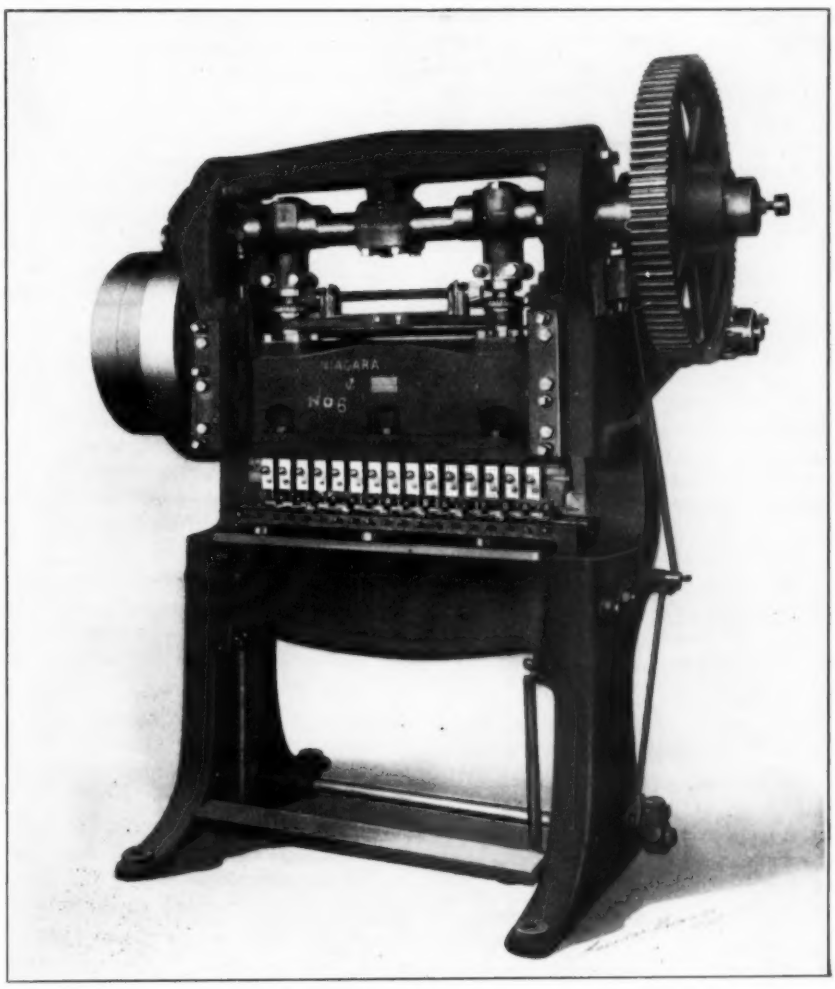
The table and knee slides are operated by rack, pinion and lever. Both vertical and longitudinal slides are provided with stops.

The spindle bearings are conical, and all take-up both front and rear is by means of a single adjusting nut. The spindle is hardened and ground, and runs in hard bronze bearings.

The machines are supplied with either a taper hole in the spindle end or with draw-in collets. These millers are built in two sizes and are mounted on a gray-iron pan-shaped base to receive oil and chips. The principal dimensions are: Longitudinal feed of table, 4 inches and 5¼ inches; cross-feed, 2½ inches and 3 inches; vertical range, 4 inches and 5 inches; front bearing, 1⅜ by 2⅛ inches long, and 1⅝ by 2⅜ inches long; rear bearing, 1⅜ by 1 13-16 inches long, and 1⅝ by 2 inches long. Maximum capacity of split collets clear thru, ½ inch and ⅝ inch; maximum size of taper hole, if so ordered, No. 2 Morse, and for the larger size, No. 3 Morse. These millers are built by the Waltham Watch Tool Company, Springfield, Mass.

A LIGHT POWER GANG PUNCH.

The half-tone shows a machine for punching rows of holes along the edges of sheets for light tanks for kitchen ranges and similar work. The capacity of the machine is thirty ¼-inch holes thru material up to 3-16 inch thick. The distance between the uprights is 38 inches, but the gap permits sheets of any length to be handled. Each punch and die holder is made separately, which makes it more convenient for changing the spacing and also for removing or replacing any individual punch or die. Any punch holder can be removed without disturbing the others. The lower dies and bushings are fastened in a dove-



A LIGHT POWER GANG PUNCH.

tail groove by set-screws for each. An adjustable back gage determines the distance from the edge of the sheet to which the holes are punched, this ranging from ½ to 1½ inches.

The machine has a strong frame, the top bar carrying a central bearing for the crankshaft which is a steel forging. A clutch of the sliding key type controls the motion. The ratio of the gears, which are machine cut is 6 to 1. The pitmans are adjustable simultaneously by the bevel gears so that the slide is always parallel with the bed. They have large spherical contact on their lower ends. The hight between bed and slide is 10 inches when the latter is at its highest. The punch as shown weighs about 5,000 pounds. It is designated as Niagara Power Gang Punch No. 6, and is built by the Niagara Machine & Tool Works, Buffalo, N. Y.

New Publications.

"Steam Pipes: Their Design and Construction." By Wm. H. Booth. 187 5½x8½-inch pages, with 62 illustrations. Norman W. Henley Publishing Company, New York. Price, $2.

Our readers will recognize the author of this book as one of our English contributors. He has had large experience in the design and operation of steam-power plants, and his book is of corresponding value. Some of it will seem rather odd to American readers; for instance, at the opening of Chapter III on Materials, we find the statement: "No material is so convenient, or has been so largely employed as cast-iron." The large use of this material for steam pipes in England is the more surprising because of the fact that for many other purposes for which American engineers use it freely English engineers consider it entirely unsuited. Other portions of the book, however, will be found quite as applicable to American practise as to English, especially those relating to the layout of complicated pipe lines and the proportioning of the pipe, together with chapters on drainage, separators and superheated steam, and apart from these the American reader will find the illustrations of English practise both interesting and instructive. The book is of a very practical nature, and contains many useful tables.

Personal.

L. O. Danse has taken the position of superintendent of the Four Wheel Drive Wagon Company, Milwaukee, Wis.

H. C. Gilman has been appointed superintendent of the Philadelphia Gear Works. He has been with the concern ten years, and for the past three years has been foreman.

Charles Ducas, M. E., who was formerly editor of the *Railroad Gazette*, has become associated with Ray D. Lillibridge, in the business of technical publicity, at 170 Broadway, New York.

Archer Richards, recently chief draftsman for the Wason Car Company, of Springfield, Mass., has resigned to accept the position of chief draftsman for the Roberts & Abbott Company, engineers, Cleveland, Ohio.

Geo. N. Saegmuller, who was for some years Chief Mechanician of the United States Coast Survey and latterly has been in the business of manufacturing engineers' and scientific instruments in Washington, has joined forces with the Bausch & Lomb Company, of Rochester, N. Y., and a new company has been formed to be known as the Bausch-Lomb-Saegmuller Company. The business will be carried on in Rochester. Mr. Saegmuller stands very high among mechanicians, and has devised and built very many original and high-class instruments of precision for engineering and astronomical work.

Obituary.

William Stellwagon, formerly master mechanic of the Reading Railroad shop at Palo Alto, died at Pottsville, Pa., April 26, seventy-four years old.

William Brewster Wood, a retired iron manufacturer, died in Philadelphia, April 21. He was a grandson of Alan Wood, founder of the Alan Wood Iron & Steel Company and a descendant of Elder Brewster, of the "Mayflower." He is said to have possessed one of the finest private libraries in the country.

The secretary of the American Society for Testing Materials transmits to the members the official announcement of the death of Prof. L. von Tetmajer, president of the International Association for the Testing of Materials. Prof. Tetmajer's death took place in Vienna January 31. In the midst of a lecture he was giving he was stricken with apoplexy from which he did not recover. Prof. Tetmajer was a man of exceptional ability and contributed very much indeed to the world's knowledge of exact and scientific methods of testing materials. Educated at the Zurich Polytechnic, he began to lecture there in 1873, and most of his contributions to the solution of his special problems have appeared in the *Mitteilungen der Anstalt fur Prufung von Baumaterialien am Eidgenossischen Polytechnicum zu Zurich*. When the first International Congress for the Unification of Methods of Testing Materials met at Zurich, in 1895, Tetmajer was elected president, and he also presided over the subsequent congresses at Stockholm in 1897, and at Budapest in 1901. He did a great deal to overcome the prejudices against Thomas steel rails, and he has also been successful in finding applications for blast-furnace slag. His great work on "Elasticität und Testigkeitslehre" recently appeared in a third edition; in other books he dealt with Basic Converter Iron, Thomas Steel Rails, the Influence of Punching on the Strength of Iron, and with Slag Cements. Having conducted the department for material testing at Zurich for more than twenty years, he accepted a call to the Technical High School at Vienna, which soon appointed him rector. He had been there three years at the time of his death.

Business Items.

The Page-Storms Drop Forge Company, of Springfield, Mass., states that it has brought out a new line of general purpose wrenches and are making them in five sizes, from 6¼ to 10¼ inches.

The Ridgway Machine Tool Company, of Ridgway, Pa., has appointed the Hallidie-Henshaw-Bulkley Company, Seattle, Wash., agent for its various tools.

The Ridgway Machine Tool Company, of Ridgway, Pa., has sold a 48-inch planer of especially heavy design and to be driven by a 30 horse-power motor, to McIntosh, Hemphill & Co., of Pittsburg, Pa.

The Bemis & Call Hardware and Tool Company, manufacturer of various types of wrenches, has just added three new sizes to its machinists' wrenches, "Merrick" pattern, and are now making these in 6, 21 and 24 inches, in addition to its regular sizes. The 21- and 24-inch sizes are made with steel handles.

The International Steam Pump Company announces the appointment of F. H. Jones as general sales manager. Mr. Jones has been for five years manager of the air compressor and power pump departments and in charge of special government work for the company. He is a graduate of Cornell University, class of 1880, and immediately after leaving college entered this branch of work.

The Hamilton Machine Tool Company has purchased the entire business and plant of The Belmer Machine Tool Company, of Cincinnati, Ohio, and will hereafter manufacture the line of planers made by that concern; these range in size from 30 to 96 inches between the housings. The company is now erecting extensive additions to its plant at Hamilton, Ohio, where the two enterprises will be combined.

The Cincinnati Milling Machine Company has been compelled to make an addition to its plant aggregating 20,000 square feet of floor space. This will consist of two buildings, one to be used as a warehouse for rough stock, and the other a one-story steel construction building with wire glass roof and concrete floor. This building will be used for heavy machine work and will be well covered by cranes. While making this addition they are arranging for a new washroom with latest devices for convenience and for proper sanitary conditions.

The Administrative County of London and District Electric Power Company, which is responsible to a Committee of the British House of Lords, is planning to construct three electric plants for generating current to supply the whole of London and those suburbs controlled by the London County Council. Each plant is to consist of six turbo-generators, each of 10,000 kilowatts normal and 20,000 maximum capacity, making a maximum total of 360,000 kilowatts. As these power units are larger than any ever constructed, experts have been appointed to decide upon the practicability of units of this size. The electrical expert chosen for this important problem is C. F. L. Brown, of Brown, Boveri & Cie., which well-known European firm acts as consulting engineer on alternating-current propositions for the Crocker-Wheeler Company, Ampere, N. J.

Manufacturers.

Frank T. McElroy will erect a new hosiery mill at Harrisburg, Pa.

The National Engine Company, Rockford, Ill., is enlarging its plant.

An addition is being built to the Paul Clemens Silk Mill, Scranton, Pa.

The Ede Robe Tanning Company, Dubuque, Iowa, will build a new plant.

Plans are being made for a dye house for the Nashua (N. H.) Cotton Mills.

The Citizens Electric Light Company, Muncie, Ind., will erect a new plant.

The Morse Plating Company, Pittsfield, Mass., is erecting an addition to its plant.

The Hockanum Manufacturing Company, Rockville, Conn., will erect a new woolen mill.

The plant of the Waterbury Chemical Company, Des Moines, Iowa, will be doubled in size.

The Sherman Envelope Company, Worcester, Mass., will double the capacity of its plant.

The Woodside Cotton Mills, Greenville, S. C., will make extensive improvements to the plant.

The Watson Paint & Glass Company, McKeesport, Pa., recently organized, will erect a plant.

Plans are being prepared for a factory building for the Main Belting Company, Philadelphia, Pa.

The Goubert Manufacturing Company, Bayonne, N. J., will erect a new foundry and machine shops.

The American Hoe & Fork Company, of Cleveland, Ohio, will erect a branch factory in Memphis, Tenn.

The Easley (S. C.) Cotton Mills will make extensive improvements to its mills to cost about $100,000.

The plant of the Giant Grip Horseshoe Company will be moved from Duluth, Minn., to Little Falls, Minn.

The Pennsylvania Salt Company, Philadelphia, Pa., is erecting an addition to its plant which will cost $14,000.

The Monmouth (Ill.) Plow Company will enlarge its plant, taking up the manufacture of a full line of farming implements.

The Stacy Manufacturing Company, Hamilton, Ohio, will build a foundry adjoining its present plant to cost about $30,000.

The Patton Paint Company, Milwaukee, Wis., is rebuilding its plant, adding two additions which will include a box factory.

The Monarch Coupler Company, Detroit, Mich., will increase its capital stock and erect a plant for manufacturing steel castings.

Plans have been completed for the erection of a $3,000 factory for the Northwestern Lithographing Company, Milwaukee, Wis.

Zehner Bros. Packing Company, Bellevue, Ohio, has received bids for the construction of a large plant which it will erect in Toledo, Ohio.

V. & F. W. Filoon, Brockton, Mass., have purchased more property. The boiler and engine rooms will be enlarged and newly equipped.

The Morgan-Wright Company will move from Chicago, Ill., to Detroit, Mich., where it will erect a new rubber goods manufacturing plant.

The plants of the Dillingham National Wall Plaster Company and the Geo. A. Taylor Flour Milling Company, Ogdensburg, N. Y., were destroyed by fire.

Leo Schwab, president of the Toledo (Ohio) Safe & Lock Company, is preparing plans and specifications for a foundry addition to his factory in Glassboro.

The Standard Manufacturing Company, Meriden, Conn., making telephone mouthpieces, etc., will move to Bridgeport, Conn., where it will erect a factory.

The Falls Company, Milwaukee, Wis., machinist, etc., is erecting a steel foundry and will make other improvements, the combined cost of which will be $250,000.

Architect W. H. Cadwell, New Britain, Conn., has drawn plans for a new factory for the Trumbull Electric Company in Plainville. It will cost about $15,000.

Cleveland Worsted Mills will enlarge its dye and finishing departments at Ravenna, Ohio, and the entire plant will be operated with electricity instead of steam.

The E. R. Wagner Manufacturing Company, N. Milwaukee, Wis., manufacturer of vehicle hardware, sheet metal stampings, etc., is planning a large addition to its factory.

The Mineral Ridge Manufacturing Company, Youngstown, Ohio, will increase and improve its plant, which will include an addition for the manufacture of steam hoists.

The Alabama Coffin & Casket Company was incorporated at Birmingham, Ala., and will erect a factory; capital, $50,000. A. M. Russell, of North Birmingham, is one of the incorporators.

The contract for erecting the new factory of the Scovill Manufacturing Company, Waterbury, Conn., has been awarded to the Flynt Building & Construction Company, of Palmer, Mass.

The Mesta Machine Company, Pittsburg, Pa., has plans prepared for a large addition to its plant at West Homestead, which will double its capacity at an expenditure of about $500,000.

The City of Montreal, Canada, has awarded the contract for a new 6,000,000-gallon pumping engine for a high-level station to the John McDougall Caledonian Iron Works of that place.

The Niagara Foundry Company has been incorporated, with a capital of $10,000, and will occupy the plant of the Tuohey Company, Niagara Falls, N. Y., making extensive improvements to same.

T. B. Rogers, of the British Columbia Sugar Refinery, Victoria, B. C., who recently returned from the Fiji Islands, has completed arrangements for the establishment of a sugar refinery on one of the islands.

A glass plant will be erected in Salem, W. Va., the citizens of that place subscribing $20,000 for the purpose. Mr. McClelland, of Weld & McClelland, Chicago, Ill., will superintend the construction of the plant.

The United Improvement Company, capitalized at $1,000,000 to erect and operate gas and electric plants, will erect a plant at Long Beach, Cal. H. S. Farnsworth, Braly Building, Los Angeles, is interested.

The Toledo-Massillon Bridge Company, which is to take over the property of the Massillon (O.) Bridge Company, has been incorporated, and in addition to the Massillon plant, will erect one at Toledo, O.

The Geo. A. Hogg Iron & Steel Foundry Company, of Pittsburg, and the Vulcan Foundry & Machine Company, of New Castle, have combined and will erect a plant at Economy, Pa., which, exclusive of equipment, will cost $100,000.

The American Agricultural Chemical Company will erect one of the largest fertilizer manufacturing plants in the South at Jacksonville, Fla. The present headquarters of the company are in the Stockton-Budd Building, that city.

A company to be known as the Bettman-Zapp Manufacturing Company is being organized, which will manufacture a patent wire holder invented and patented by Charles Bettman, of New Albany, Ind., at which place a plant will be erected.

The St. Lawrence Engine Company, to manufacture gasoline engines and launches, has been organized with a capital stock of $40,000. The incorporators are capitalists of Brockville, Ont., of whom W. H. Comstock, ex-M. P., is among the number.

The Shoshone Power Company, with a capital of $5,000,000, which will erect a plant at the Shoshone Falls, in Idaho, has been formed. The president of the company is Apostle Francis M. Lyman, of the Mormon Church in Salt Lake City.

The Kentucky Sonora Distilling Company has been incorporated at Lexington, Ky., with capital of $100,000. A large distillery will be erected in Mexico, and the principal offices will be in Lexington. John A. Simonds, M. C. Alford, E. P. Farrell, incorporators.

The Simmons Hardware Company, of St. Louis, is erecting a plant in Sioux City, Iowa, which will cost at least $300,000. Frank B. Gilbreth, of New York and Boston, has been awarded contract for erection by Gordon, Tracey & Swartwout, New York, architects.

New Catalogs.

Henry Vogt Machine Company, Louisville, Ky. Bulletin No. B-1, describing water tube boilers. Illustrated. 6x9, pp. 7, paper.

Watertown Engine Company, Watertown, N. Y. Catalog illustrating and describing engines made by this company. 7x9, pp. 32, paper.

The Frank Oil Company, Titusville, Pa. Price list of various oils and greaess. 6x8½. Price list of various oils and greases. 6x8½, pp. 6, paper.

Double-Friction Coil Clutch Company, 42 River street, Chicago, Ill. Catalog describing clutch made by this company. Illustrated. 3½x6, pp. 12, paper.

A. J. Machek, 401 Nineteenth street, Milwaukee, Wis. Circular describing "Tubular" micrometer caliper frames and "Precision" bench shears. Illustrated.

Hart-Parr Company, Charles City, Iowa. 1905 edition of "Hart-Parr Blue Book," describing traction and portable oil-cooled gasoline engines. Illustrated. 6x9, pp. 30, paper.

The Nelson Valve Company, Wyndmoor, Pa. Illustrated catalog and price list "G" of improved gate and globe valves for steam, water, gas, air, ammonia, etc. 6x9, pp. 53, paper.

Wagner Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 70, illustrating and describing single-phase motors for elevator, hoist and traveling crane service. 6x9, pp. 4, paper.

The Reliance Machine & Tool Company, Cleveland, O. 1905 catalog of bolt threading, pipe threading and nut tapping machinery and accessories. Illustrations, price lists and tables. 6x9, pp. 56, paper.

Corliss Engine Works, 4041 North Fifth street, Philadelphia, Pa. Catalog of the Rickards Corliss steam engines, containing illustrations, testimonials and list of users. 6x9, pp. 16, paper.

The Adams Company, Dubuque, Iowa. Catalog entitled "A Study of the Adams-Farwell Motor Car," containing very full information about this car, half-tone illustrations and line drawings. 6x9, pp. 23, paper.

The Murphy Iron Works, Detroit, Mich. Catalog describing the improved Murphy automatic smokeless furnace. This is printed on fine coated paper and has numerous excellent half-tone illustrations. 6x9, pp. 31, paper.

C. W. Hunt Company, West New Brighton, N. Y. Catalog describing the Hunt noiseless conveyor and other machinery for handling coal and ashes in power stations. Half-tone illustrations and line drawings. 7x9, pp. 52, paper.

Buffalo Forge Company, Buffalo, N. Y. Pamphlet describing and illustrating the Buffalo fan system of heating and ventilating. 3½x7, pp. 20, paper. Also pamphlet describing engine made by this company. Illustrated. 3½x7, pp. 16, paper.

A. D. Granger Company, 95 Liberty street, New York. Bulletin No. 4 describing Vulcan shaking and dumping grates, stationary grates of all patterns, cast iron boiler fronts, steel plate boiler fronts, other boiler castings. Illustrated, 6x9, pp. 23, paper.

Frank A. Simonds, Houseman Building, Grand Rapids, Mich. Pamphlet, "Economical Steam Heating and How to Secure It." This contains brief description of the Simonds simple and compound systems of vacuum steam heating. 3½x5½, pp. 18, paper.

H. H. Franklin Manufacturing Company, Syracuse, N. Y. Catalog describing six 1905 models of the "Franklin" motor cars. This is a handsome book containing very full information as to the merits of these cars, excellent half-tone illustrations and specifications. 6x8½, pp. 36, paper.

Crane Company, Chicago, Ill., has just issued its advance circular describing Crane steam and oil separators, which contains 26 10½x13½ sheets, printed on white enameled paper and half-tone illustrations. It will be sent to the trade on request. Ask for "Advance Circular No. 01."

Wilmarth & Morman Company, Grand Rapids, Mich. Catalog No. 90. This contains description of forty-six different styles, sizes and combinations of the "New Yankee" drill grinder, as well as reamer grinders, arbor presses and friction countershafts made by this company. Half-tone illustrations. 6x 9½, pp. 32, paper.

The Robbins & Myers Company, Springfield, O. Very handsome book containing pictures showing various sizes and types of "The Standard" motors and also examples of individual driving of machines, as well as testimonials from users of these motors. It is printed on very fine coated paper and the illustrations are excellent half-tone engravings. 8x10, pp. 37, paper.

Waterbury Brass Company, Waterbury, Conn. 1905 catalog, entitled "Brass and Copper," containing tables and weights of seamless drawn brass and copper tubes, brazed tubes, brass and copper in rod, wire and sheets, also tables which are short-cuts in arriving at certain results in figuring outside and inside diameters of seamless tubes for weights and in connection with the rod, wire and sheet in brass and copper. There is also a table of discounts. 4x7, pp. 75, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & Dies. Wal.M.Wks.,Waltham,Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Turret lathe work, light machinery, tools, models, etc. Metal Novelty Co., Elgin, Ill.

Wanted—Copy Feb. 14, 1899, AMERICAN MACHINIST. Address Box 75, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Machinist Table—Standard steam, gas and water pipe tapping sizes; 5c., stamps. E. E. Meyer, Allegheny, Pa.

Wood patterns of every description; high-grade gas engine work a specialty. Trenton Pattern Works, Trenton, N. J.

Wanted—A Brown & Sharpe automatic screw machine; must be in first-class condition. Box 91, AMERICAN MACHINIST.

Responsible concern with office in Liberty st., New York, would represent out-of-town manufacturers in the engineering or similar lines. Address R. F. 21, care AMER. MACH.

Dies, jigs and fixtures; tools designed for special work; manufacturer of clockwork specialties and intricate mechanical instruments. D. S. Plumb, 57 E. Park st., Newark, N. J.

Medium size modern plant wants contracts; close work on automatic and interchangeable machinery; will buy good tool or machine, or manufacture on royalty. Box 521, AM. M.

W. H. Chappell, the best shop organizer and manager in America and inventor of the red light system, solicits correspondence regarding engagements. Box 57, AM. MACH.

Wanted—Manufacturers to use premium system; shop cost reduced; output increased; no trouble with employees; system successfully installed; results guaranteed. Box 525, AMERICAN MACHINIST.

A mechanical engineer about to open an office in New York city to conduct a consulting and contracting engineering business desires to represent some Western manufacturing concern; well acquainted with the trade. Herman Jonson, 106 E. 82d st., New York.

Modern foundry and machine shop, fully equipped for light and medium heavy work, wishes to manufacture engines, machines or machine parts; would undertake sale if desired; castings made in malleable, gray, brass, bronze and aluminum. Trenton Malleable Iron Co., Trenton, N. J., and 26 Cortlandt st., New York.

For Sale.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

For Sale—Wheeler planer, 7 ft. platen, planes 27 in. wide and 24 in. high; vise, centers, angle irons, parallels, tools; a fine, heavy tool, in good order; all f. o. b. Brockton, Mass., for $250. Wm. A. Sweetser, 20 Keith ave., Campello, Mass.

For Sale—Patent issued 1900, automatic lock for dumbwaiters, hoists, elevators, etc.; have sold over 3,000; able man could clear $5,000 to $15,000 yearly; manufacturers and mechanics with capital should investigate; low price. Address "Patent," AMER. MACH.

Business Opportunities.

We want a few thousand dollars to enlarge our business, and desire to interest a party who will take an active interest either as salesman, machinist or pattern maker. Address P. O. Box 216, Lewiston, Idaho.

Gentleman of long experience in construction, operation and installation of machinery of different classes, both mechanical and electrical, desires to enter partnership with a practical machinist in a good locality. Box 71, AMERICAN MACHINIST.

A practical mechanic wants to form a business connection with a technical, mechanical and electrical engineer—equal capital—to conduct a consulting and contracting business; location New York city. Address Box 78, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Position as toolroom foreman or model room; 15 years' experience on designing and experimental work; can give reference. Box 72, AMERICAN MACHINIST.

Situation Wanted—A first-class mechanic, 7 years as superintendent of a large plant, past 2 years master mechanic; experienced on large and small tools, press work and dies, plating, steam, electric, wood-working and automatic machinery; capable of handling successfully most any class of manufacturing; can not only direct, but can do; a close student, and a large, well-developed experience. Box 38, AMERICAN MACHINIST.

ILLINOIS.

Man familiar with machinists' supply prices wants position with manufacturing company as purchasing agent; five years' experience with Chicago house. Address Box 85, AM. M.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 97, AMERICAN MACHINIST.

Wanted—Position as general foreman; 14 years' experience on engines, air compressors and electrical machine work. Box 84, AM. M.

Gray iron foundry superintendent wishes to change; engines, machinery; practical in all departments; up to date; good references. Address Box 47, AMERICAN MACHINIST.

Superintendent or assistant, practical, 12 years' experience, experienced toolmaker on tools, jigs, fixtures, tempering high-speed steels for rapid production and economy, unquestionable references, capable executive ability, systemizer and inventive ingenious, seeks position with concern wishing to increase production without additional expense. Box 73, AMERICAN MACHINIST.

MICHIGAN.

Foreman toolmaker, with a university education and considerable experience as draftsman on special machinery and tools for economic manufacturing, wants employment in Central West. Box 79, AMER. MACH.

Change desired by superintendent of plant employing 1,000 hands on highest grade of interchangeable work; present contract expires June 1; technical and practical training of 20 years; understands the art of getting the maximum output at a minimum cost; can install good shop system. Box 66, AM. M.

NEW JERSEY.

Machine draftsman open for position. Box 36, AMERICAN MACHINIST.

Designer—Small machines, typewriters, etc.; also tools for cheap manufacturing; presently employed; wishes position as chief draftsman or foreman. Box 94, AM. M.

NEW YORK.

Experienced mechanical draftsman wants position. Box 88, AMERICAN MACHINIST.

Mechanical draftsman desires position. Address Box 90, care AMERICAN MACHINIST.

Mechanical draftsman having 7 years' experience desires steady position. Box 81, A. M.

Mechanical draftsman, tools and special machinery, wishes position. Box 68, AM. M.

Position by a practical, up-to-date foundryman; 20 years foreman; A1 reference. Box 67, AMERICAN MACHINIST.

Practical instrument maker desires change; A1 on electrical and experimental work. Box 76, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, experienced in shop and office, wants position; best references. Box 95, AM. MACH.

Mechanical engineer, graduate of American School at Armour Institute, desires position as draftsman; $15 week. Box 70, AM. MACH.

Thorough mechanic, age 29, inventive and executive ability, foreman 8 years, desires change. Steam or gas engines preferred. Box 64, AMERICAN MACHINIST.

Designer of leading American automobiles open for engagement; go anywhere; best references; age 30; expert shop organizer and cost reducer. Box 60, AMER. MACH.

Young machinist, with some technical knowledge, wants anywhere steady position with chance of advancement; could invest $2,000. Answer under E. Sch., care AM. M.

Foreman on small work; 18 years' experience, 4 years foreman; experienced hardener; can make drawings of tools, good estimator; 34 years old, married, strictly temperate; references. Box 83, AMER. MACH.

Civil engineer (German), with extensive experience in general machine construction and office management at European mercantile and government shipyards, seeks similar position in this country, with either public or private industrial concern. Address Box 39, AMERICAN MACHINIST.

Experienced foreman desires position to take charge of experimental and tool work or light manufacturing; A1 mechanic; age 30; inventive ability; able to design and im-

prove tools; technical education; thorough knowledge of electricity and drafting. Box 77, AMERICAN MACHINIST.

Works manager, capable of reorganizing a manufacturing business not earning dividends or improving present earnings and conditions; past work has been decidedly successful in the manufacture of machinery; iron, steel and brass lines; efficient methods, coupled with energy, tact and judgment; practical, technical and commercial training. Box 92, AMERICAN MACHINIST.

Joseph V. Woodworth will be open for an engagement after June 1 as mechanical expert and reducer of manufacturing costs with concern in Greater New York or vicinity manufacturing large quantities of interchangeable machine parts or duplicate articles of metal; an expert in accurate steel treatment; eliminator of hand labor; designer of rapid operating jigs, tools, dies and fixtures. Concerns willing to suitably compensate a broad gauge specialist of established reputation—a man who can secure the maximum of output at the minimum of cost—kindly communicate and arrange for a personal interview. Address 367 Vernon ave., Brooklyn, N. Y.

PENNSYLVANIA.

Draftsman, 6 years' experience, good on detailing, desires position. Box 53, AM. M.

Position as head of tool department, engines, machine tools, or work of similar character. Box 89, AMERICAN MACHINIST.

Engineer in full charge of engineering end of an annual business of $200,000 desires change; wide and successful experience. Box 74, AMERICAN MACHINIST.

Cost accountant wishes change, now employed with large manufacturing company, charge costs; experienced in systematizing factory and office accounting and making piece-work prices. Box 96, AMER. MACH.

Mechanical draftsman, German, college graduate, 2 years' shop experience, 2½ years' office experience special tool machines and hydraulic presses, wants position; will go anywhere. Box 1, AMERICAN MACHINIST.

Machinist, German, 28, single, desires position as foreman; 13 years' experience on presses, dies, special machinery; good draftsman and designer; inventive; knows how to handle men; prefers small and medium or experimental work. Box 93, AMER. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers. Apply to Ross Rifle Co., Quebec, Canada.

Wanted—First-class draftsmen on tool and gauge work. Apply Ross Rifle Co., Quebec, Canada.

First-class operator for Landis grinder; state age, experience and wages expected. Box 86, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Good all-around machinists on engine and general machine work; good pay and steady work. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

ILLINOIS.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, "Patterns," Box 34, AMERICAN MACHINIST.

Wanted—A first-class machine foreman to take charge of 35 or 40 machine hands operating lathes, planers, milling machines and gear cutters; a man only who can get out high-grade work at low cost and handle men need apply. Box 37, AMER. MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MASSACHUSETTS.

Wanted—First-class printing machinery draftsman and designer. Box 69, AM. MAC...

Wanted—Machinist for general gear cutting work; one accustomed to Fellows gear shapers preferred; also want one man for cutting spirals. Address "Gears," care AM. M.

Foreman—For a growing factory building scientific apparatus, want a rapid worker, having ability to design details; good opportunity for the right man. Box 5, AM. MACH.

Wanted—A first-class draftsman on small automatic machinery, tools, etc., and designing; up-to-date factory in Worcester County; state age, experience and wages expected. Address Box 46, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Mechanical draftsman; preferably familiar with hoisting machinery and cranes. Address, stating terms and experience, Northern Engineering Works, Detroit, Mich.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern and up-to-date methods. To honest, competent men who will "do things" steady work and first-class wages are waiting. State experience, age, references, and full information. Cadillac Automobile Company, Detroit, Mich.

NEW JERSEY.

Good machinist used to gasoline engine and boat work; give experience and wages desired. E. B. C., AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Machine designer or mechanical superintendent with some knowledge of electricity, experienced in the design and operation of soft metal casting and other machinery; state age, etc., training, experience and salary expected. Box No. 82, AMER. MACH.

First-class boring-mill, lathe and planer hands should file applications with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—First-class draftsman; preferably familiar with pumps; give experience, etc. Box 24, AMERICAN MACHINIST.

Manufacturing company, established 1852, high standing, dividend paying and with surplus, desires active business associate or foundryman; salary. Box 87, AMER. MACH.

Wanted—First-class wood-working machine hand; must be able to read blueprints and lay out work. Address, by letter only, F. M. L., Room 29, No. 38 Park Row, New York.

Wanted—Several first-class draftsmen; give age, experience, reference and salary expected. Apply to Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Experienced man to check drawings on light interchangeable work; must be capable of discovering errors in figures, unmechanical details and features involving undue difficulty or expense in machining or assembling; state age, education and salary expected and outline previous experience; location, central New York. Address Box 49, AMERICAN MACHINIST.

OHIO.

Draftsman Wanted—Familiar with automobile work preferred. The Royal Motor Car Co., Cleveland, Ohio.

PENNSYLVANIA.

Machine and floor hands, familiar with machine tool work. Standard Engineering Works, Ellwood City, Pa.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—First-class draftsman on mill construction and equipment; technical man preferred. Box 4, AMERICAN MACHINIST.

Wanted—Lathe, planer and boring mill operators for night shift; men accustomed to machine tool work preferred; steady work to good men. Address Colburn Machine Tool Co., Franklin, Pa.

TEXAS.

Wanted—Superintendent for our machine shop, working about 30 men now, but expect to enlarge shortly; our work is general repairs on sawmill, cotton oil mill and sugar machinery engines, locomotives, marine engines and pumps; we also build new rotary pumps and other machines on orders; have no special machine line that we manufacture; our general foundry is well equipped and under capable management; must be competent to make estimates on all work, a handler of men—in fact, a first-class man. Address, with full particulars as to former work, salary, etc., Dickson Car Wheel Co., Houston, Texas.

WEST VIRGINIA.

Wanted—Machinist familiar with die and repair work; state where last employed and amount of wages desired. Wheeling Stove & Range Co., Wheeling, W. Va.

WISCONSIN.

Wanted—Several draftsmen and detail men for Corliss engine work. Apply to Brown Corliss Engine Co., Corliss, Wis.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed. Give full experience and reason for changing. Shop experience great advantage. All letters acknowledged and held confidential. Box 80, AMER. MACH.

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Brakes, Magnetic Friction
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Armstrong Bros. Tool Co., Chicago, Ill.
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Nolte Brass Co., Springfield, O.
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Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

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Massey Mach. Co., Watertown, N. Y.
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Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel
Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

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Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
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Centers, Planer
Fay & Scott, Dexter, Me.
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Pratt & Whitney Co., Hartford, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
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Jeffrey Mfg. Co., The, Columbus, Ohio.
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Potter & Johnston Mach. Co., Pawtucket, R. I.
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Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker & Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.

Chucks, Split
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Hardinge Bros., Chicago, Ill.

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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Smith Co., Chas. G., Pittsburg, Pa.

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Electric Controller & Supply Co., Cleveland, O.

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Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
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International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Blanchard Mach. Co., Boston, Mass.
Dale, R., New York.

Controllers and Starters, Electric Motor
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Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Solcomb Co., J. T., Provi., R. I.

Countershafts
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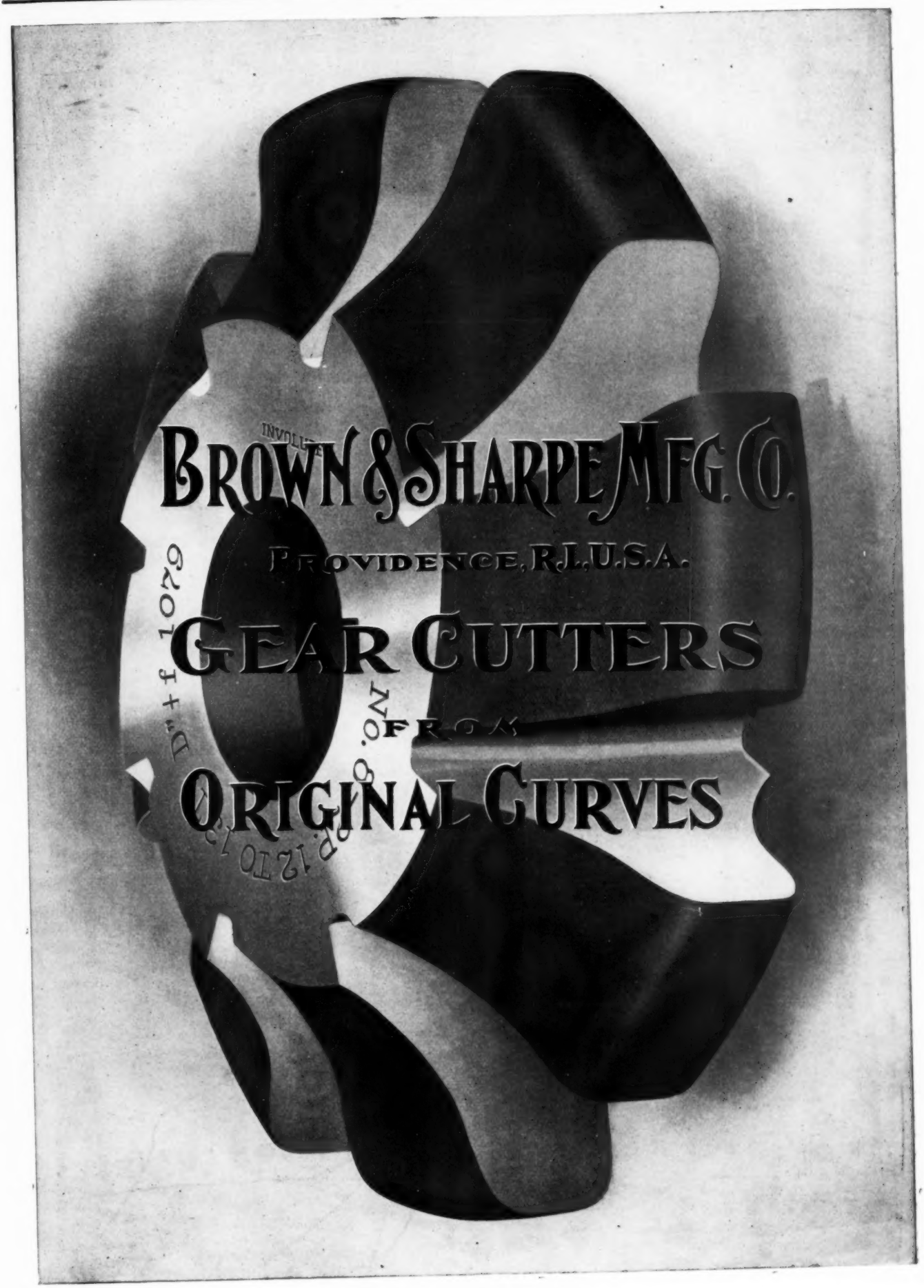
Builders' Iron Fdry., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Electric Controller & Supply Co., Cleveland, O.
Nicholson & Co., W. H., Wilkesbarre, Pa.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Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Inc., Detroit, Mich.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Inc., Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mch. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
Dickinson, Thos. L., New York.
Osgood, J. L., Brooklyn, N. Y.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Gem Mfg. Co., Pittsburg, Pa.
Lutter & Gies, Milwaukee, Wis.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Perkins Mach. Co., Warren, Mass.
Swaine, Fred. J., St. Louis, Mo.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co. New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drill Blocks and Gages
Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roos & Mill, Cincinnati, O.
Smith & Co., Chas. G., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Burke Machine Co., Cleve., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. F., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Cairke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Valentine Gas Engine Co., Plainfield, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.

Dynamos—*Continued*
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
American Elec. & Controller Co., New York.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Pierce-Crouch Engine Co., New Brighton, Pa.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Burt Mfg. Co., Akron, O.
Sturtevant Co., B. F., Hyde Park, Mass.

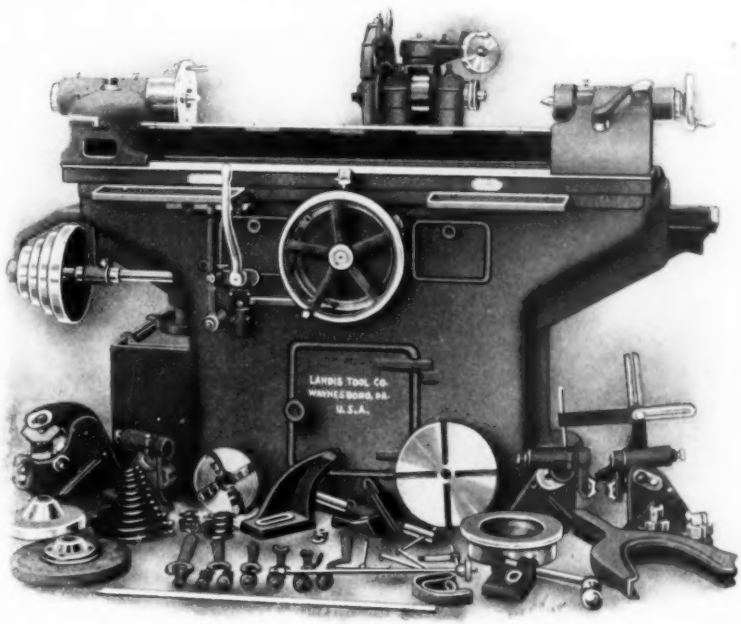
Study These Examples of Work

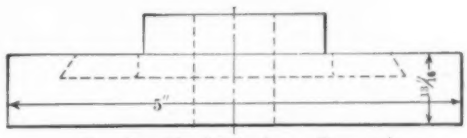
Note how much was removed, and note the time required to remove it on this No. 3 Landis Universal Grinder.

Can you equal it by any other device?

Bear in mind that this is the every-day rate of reduction with a Landis, not record time. You or any practical man can do as well with this machine.

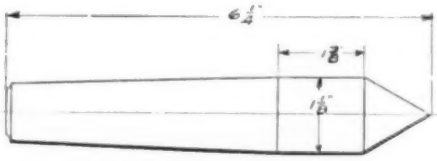
You can grind on it anything that can be ground on centers up to 12 in. swing by 42 in. long. It is equipped with every necessary chuck, rest, spindle, arbor, etc., for general shop work. We'll send you special bulletin of this or any other of the general Landis Grinders. The No. 3 is the most useful for the average machine shop.





Cast Iron Hand Wheel. .010 Removed from Face and Side in 6 Min.

No. 4 Mach.



Cast Steel. .010" Removed all over and Taper fitted in 12 Min.

No. 3, Mach.

Landis Tool Company, WAYNESBORO, PA., U.S.A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

High Duty Bolt Cutter

The new die scheme of the Landis Bolt Cutter marks the most important change in bolt cutting of modern times. It does away with practically all of the ills of the old style cutters, inaccuracy, frequent renewing of dies, etc. The chasers of the new style die can be set forward as fast as worn, giving twenty times the service of a hobbed die.

LANDIS MACHINE CO., - Waynesboro, Pa., U.S.A.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Extinguishers, Fire
Badger & Sons Co., E. B., Boston, Mass.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filters, Oil
Burt Mfg. Co., Akron, O.
Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Mach. Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Page-Storms Drop Forge Co., Springfield, Mass.
Solid Steel Tool & Forge Co., Pittsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Lang Co., G. R., Cincinnati, O.
Page-Storms Drop Forge Co., Springfield, Mass.
Solid Steel Tool & Forge Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Byram & Co., Inc., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messner Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.

Gears, Rawhide—*Continued*
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cncin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Kingston, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Walker & Co., O. S., Worcester, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.

Grinding and Polishing Machines—*Continued*
Burke Mach. Co., Cleveland, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Smith Co., Chas. G., Pittsburg, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner, & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Modern Methods of Manufacturing Welded Chain.

BY LESLIE B. POWELL.

It is perhaps not generally known that the United States is not only the largest producer but also the largest consumer of welded chain in the world, and that its annual production reached, in the year just ended, the 50,000-ton mark. This industry is probably one of the best examples of large growth made possible by the introduction of the latest types of labor-saving machinery. The increasing demand for this product, which was greatly in excess of the production in 1901-2, resulted in many plants being started in the following year, and 1904 found the production slightly in excess of the consumption. The present era of prosperity and the general resumption of all manufacturing business finds the production of welded chain greater than ever before, and the prospects for a most satisfactory year are of the brightest.

This industry is what one might call a transplanted industry, as in former years England supplied us with all our chain, but our consumption reached such proportions that it was found necessary for us to enter this field as manufacturers. As an accompaniment of the transplanting, the processes and the product have been corrected, improved and developed until to-day American chain is recognized as a standard.

The manufacture of chain requires essentially skilled labor and the most modern machinery, as on these depend not only the quality of the finished product but also the low cost of the production. The illustrations given herewith show three of the latest and most important examples of labor-saving machinery, devised and adapted to meet the demand for greater production and better quality.

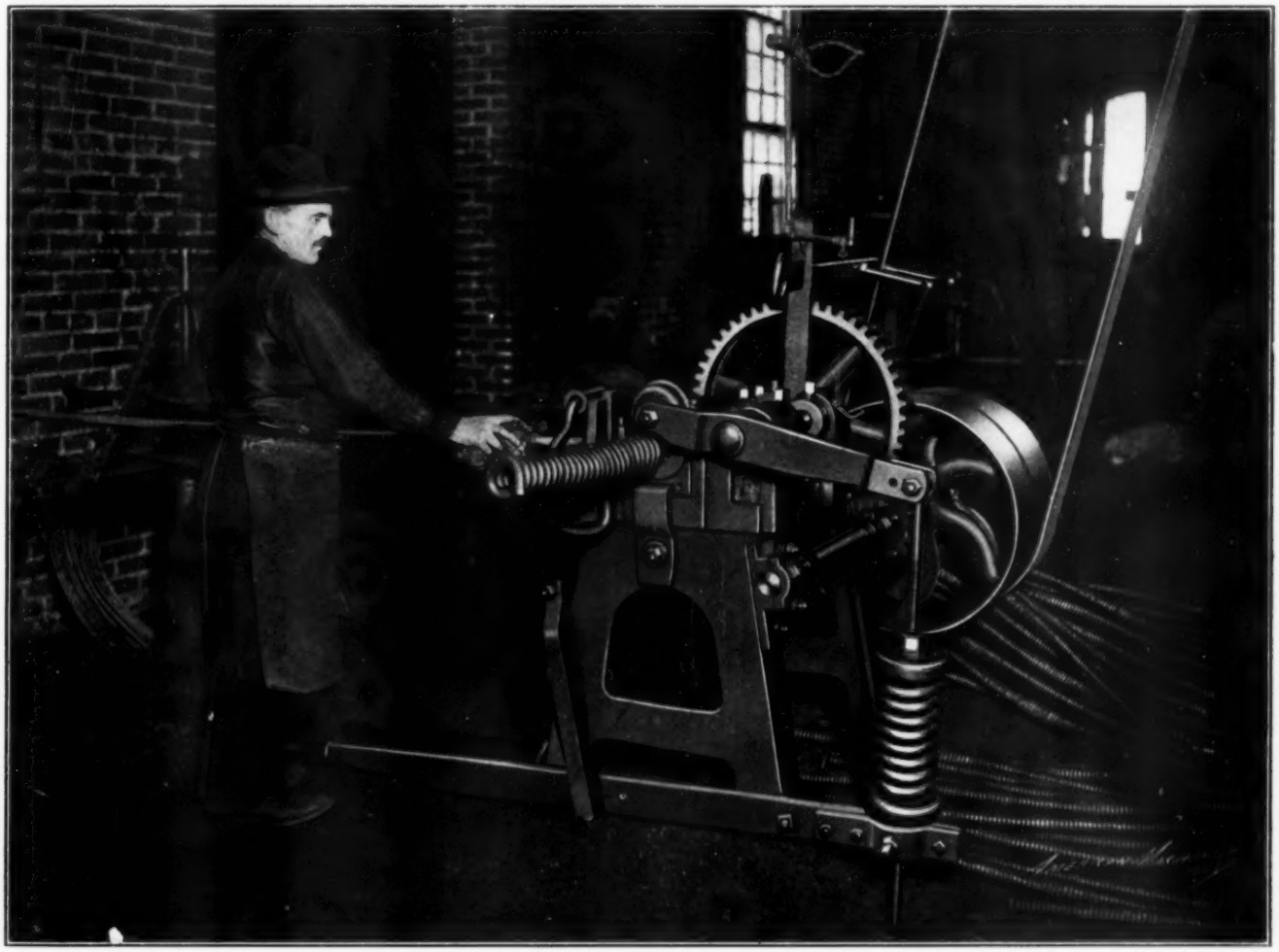


FIG. 1. LINK WINDING MACHINE.

In order that the value of these three machines in modern chain manufacture may be more clearly seen, the old method of manufacture, as it is still carried on in some parts of Europe, will first be described.

FORMER METHOD OF MAKING WELDED CHAIN.

Taking, for example, the way in which 7/8-inch common chain was formerly made, we find that the smith placed in his fire several pieces of 7/8-inch straight, round iron which had been previously cut to the required length. As one of these reached the proper heat, about a cherry red, it was withdrawn, one end placed in a hole in the anvil, the bar hammered with a hand hammer into a rough U shape, and then placed back in the fire for another heat, and in the meantime another piece which had been heated was bent into the U shape and so on.

The first U-shaped link, having reached almost a white heat, was taken from the fire, its open end hooked thru the link last welded, laid flat on the anvil and one end of the U link drawn with the hand hammer to a taper of about 60 degrees with the diameter of the bar. This was called scarfing the link, and when one end was thus scarfed the link was turned over and the other end scarfed in a like manner, so that both ends were drawn to a taper, but on opposite sides. The link was then placed on the horn of the anvil and the ends bent toward each other, so that the scarfed ends lapped, after which it was laid flat on the anvil, and these scarfed ends hammered closely together. This process completed the oval shape of the link, and it was placed back in the fire for the final and welding heat. When this was reached, the link was withdrawn from the fire and the scarfed ends were welded as the link was turned over and back, so

that every portion of the part of the link being welded should receive the proper working that was necessary to secure a perfect weld. By this process the smith could not weld over 250 pounds of 7/8-inch common chain per day, this being equivalent to 31 feet or 156 links as a day's work, and while the quality of the chain produced in this manner was of the best, it was found that by performing part of the labor by machinery the production could be quadrupled and the quality bettered.

PRESENT METHOD OF MAKING WELDED CHAIN.

Under the present process of manufacture, we find that the long bar is now wound into a spiral of links on a link-winding machine, and then cut up into links on the link-cutting machine, the cutting process forming the scarfs on the ends of the links, these two machines saving the smith the cutting, bending and scarfing of the links, and doing away with two heatings of the iron that were necessary under the former process, as the winding and cutting are done with the iron cold.

THE LINK WINDER.

The link-winding machine, Fig. 1, consists of a horizontal shaft about 4 feet long, which is operated by a belt and pulley geared to one end, while on the other end is attached the winding mandrel or link former. This mandrel can be changed according to the links that are to be wound, and has outside dimensions conforming to the inside dimensions of the required link. One end of the bar of iron is fastened over this mandrel by a movable attachment, and a grooved guide wheel is lowered to meet the bar and press it firmly on the mandrel by means of a powerful spring. As the machine is started, the shaft slowly revolves and the iron is wound tightly around the mandrel in the form of a spiral or tight spring, the pressure of the grooved guide wheel forcing the iron to conform exactly to the desired shape. When the bar has been entirely wound up the result is a spiral of links about 6 feet long, ready to be cut into links. By means of this machine 9,000 pounds of bar iron can be wound into spirals in one day, equal to about 5,000 links. In some rolling mills which supply chain manufacturers with rods, they have link-winding machines placed so that the bar of iron can be wound hot into spirals as it comes from the rolls, as by so doing the link winder can be run at a higher rate of speed, resulting in greater daily production and with less waste than by cold winding.

THE LINK CUTTER.

The link cutting machine, Fig. 2, consists of one fixed lower cutting blade and one sliding upper cutting blade, which slides in a groove and is operated by belt and pulley gears. The spirals are fed into the cutting blades from the left side of the cutter and held in such a manner that the iron is cut at an angle of 60 degrees with the diameter of the rod, each cut releasing one link, wound and scarfed ready for welding, and at the rate of one cut every second, or 36,000 links per day.

THE WELDING MACHINE.

The power hammer on which chain is now welded is shown in Fig. 3, and represents the result of years of experiment and trial. When the idea of welding the links of a chain by means of dies instead of by blows of hand hammers was first conceived, a foot-power hammer was attached to the anvil, the hammer being hinged on the opposite side of the anvil from the smith and so arranged that by kicks on a foot treadle the smith could swing the hammer arm down to meet the face of the anvil. In the lower face of the hammer arm was attached the upper die, and on the face of the anvil was attached the lower die, the result being a smooth finish superior to that of a ham-

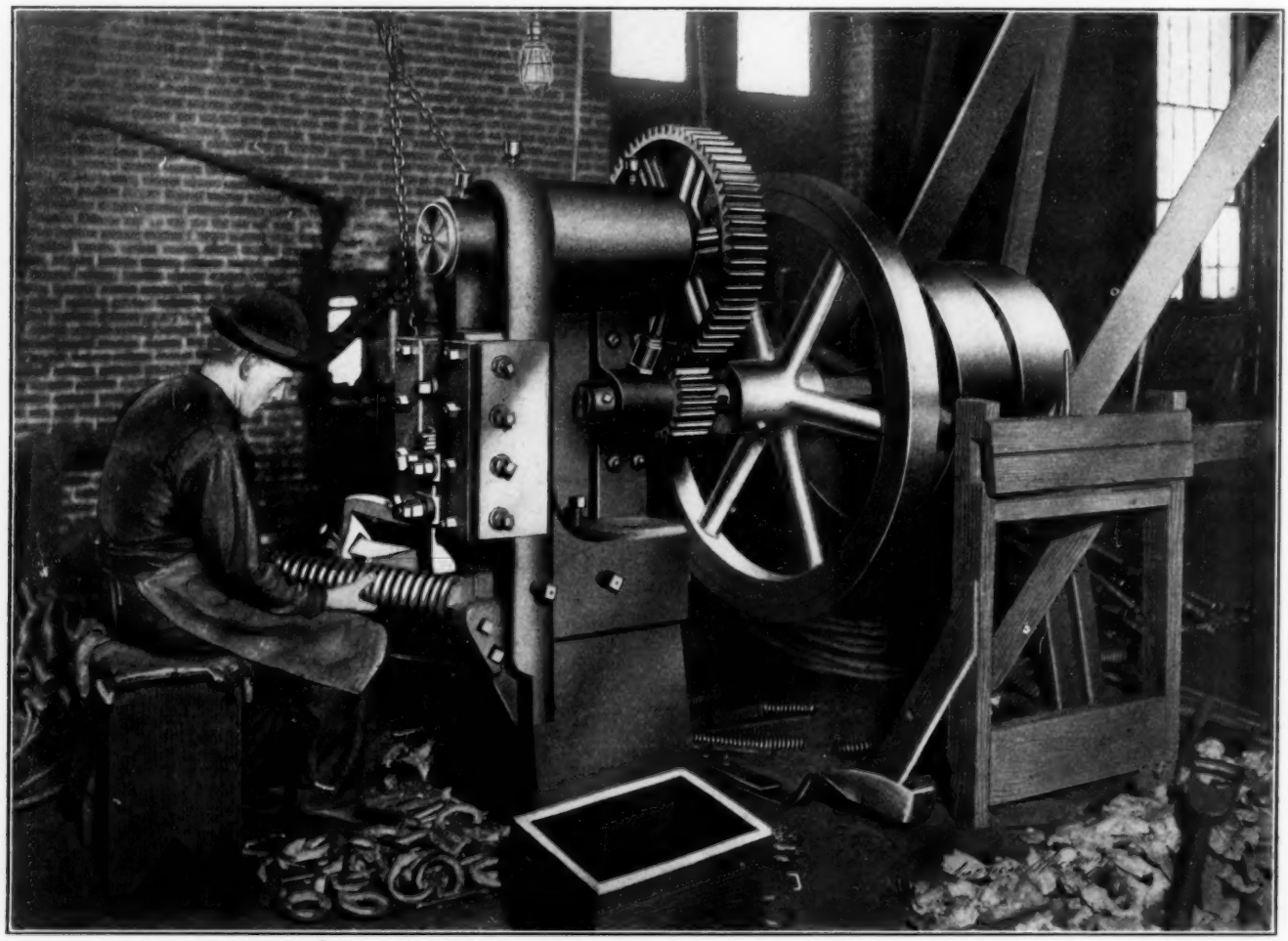


FIG. 2. LINK CUTTING MACHINE.

mer welded link. This was a big step in the right direction, but it was soon found that on large sizes of chain the labor of operating the hammer arm by foot-power was too great and the present well-known type of power-operated hammer was devised to obviate this difficulty. The power for operating this type is conveyed to a pulley on the hammer base by means of a belt from the shafting of the shop arranged to give the hammer a speed of about 120 strokes per minute. The weight of the hammer arm is in its head and the force of its blow is due both to gravity and to the pulling power exerted by a powerful spring. The machine is so arranged that when not in use the arm is raised about a foot from the face of the anvil and held there by a catch, so that

FIG. 3. THE WELDING HAMMER.

when this catch is removed by a pressure on the foot treadle, the hammer will fall heavily on the face of the anvil. The pulley on the hammer base operates a short shaft carrying an elliptical cam and is so arranged that when the hammer arm is caught and held up from the face of the anvil the cam will not meet the base of the arm, but when the arm has been released and descends on the anvil the base of the arm is brought within reach of the rotating cam, which strikes the base of the arm and raises the arm about a foot from the anvil, when further rotation of the cam releases the arm and permits it to fall again. This operation continues until the link has been welded, when by releasing the foot treadle the arm is caught and held up until another link is ready to weld.

By means of this hammer 1,000 pounds of ⅞-inch chain can be welded in one day, equivalent to 124 feet or 626 links, being four times the daily production under the old hand-hammer process.

THE DIES.

In regard to the dies used, the lower die consists of a block of steel cut away until a small rounded projection is left which will just fit inside the end of the link, while the upper die is a block of steel hollowed out so that it will just fit over the outside of the end of the link, the space between the two dies being just the size of the end of the link which is to be welded. These dies are fitted in spaces left in the face of the hammer head and the face of the anvil, so that different size dies can be used on the same power hammer, according to the size chain that is to be welded.

THE PROCESS OF WELDING.

The smith selects from the several links in the glowing bed of coke in the furnace one that has reached the welding heat and, hooking it thru the link last welded, places the open ends of the link over the lower die. Pressure on the foot treadle releases the hammer arm and the impact of the blow forces the scarfed ends closely together and welds the link, the dies reducing the body of the weld to the same size as the rest of the link and giving the weld a smooth finished appearance superior to hammer-welded chain. About ten blows of the hammer arm are required to make and finish the weld, the interval between the blows of the arm being utilized by the smith to turn the link over and back on the lower die and to lightly tap the weld with his hand hammer, thus giving the iron the proper working necessary to secure a perfect weld.

The use of these three important machines has completely revolutionized the process of chain manufacture, the result being not only greatly increased production but also a much better grade of chain and greatly reduced cost.

The Work of the Trade School.

In the discussion of a paper on "Trade Schools," recently read before the Technical Society of the Pacific Coast, George W. Dickie, of the Union Iron Works, San Francisco, spoke as follows:

The majority of tradesmen have been, and I think always will be, educated in the workshop. I noticed, however, four years ago, a tendency abroad to introduce a certain amount of technical work in the shops. I found this idea worked out and in operation in several of the large industrial institutions in England and in some places in Scotland. This I found especially the case in Berlin, where, in several large establishments, the apprentices had to spend two hours each day in the schoolroom attached to the works.

There is a large class of industries, which, from the nature of the operations, cannot be taught practically in any school. We could never expect to go to a trade school and get fitters, riveters, etc., for work in the shipyard—such work could never find a place in any school. Then, the commercial element is almost excluded from the trade training of the school; that is, the ability to do work in commercial competition with others forms no part of such teaching, and this is the most important part of trade education. One hard thing for a boy to learn is to be prompt at work when the whistle blows at 7 o'clock, and to keep steadily doing effective work until the whistle blows at 5 o'clock in the evening, and thus acquire the ability to produce enough to enable his employer to keep him steadily employed, and give him the regular compensation for such work. The schools are not required to run a profitable busines in order to keep open, and they thus fail to teach the most important thing that always confronts the tradesman; that is, that his production must be worth more in the market than the remuneration he expects to get for it.

I am quite interested in the subject, and I occasionally visit the trade schools, especially the evening schools for imparting technical knowledge to young men who are at work in the shops all day. They are doing a grand work, and they should receive support from all technical men. The day trade schools are also a great help, but we must not expect too

much from them. I do not think that they can ever take the place of the regular system of apprenticeship in the shop. We have a large number of apprentices, about 600, but not many of them come to us from the trade schools.

Some Points About Tumbler Gears.

BY A. L. DE LEEUW.

The old-fashioned, and for a time, despised tumbler gear has come back to us and has retaken its place—with a vengeance. The vengeance consists in making trouble all around and leading the unwary designer up against rocks and hidden reefs, which often wreck, or at least disable the ship which is to carry his intentions.

THE OLD-FASHIONED TUMBLER GEAR.

The old-fashioned tumbler gear was used but seldom. It was confined in its duty almost entirely to reverse motions. It could be found in aprons and headstocks of lathe, in the elevating mechanisms of radial drills, boring mills, planers, etc. It caused a little bit of trouble once in a while, because, under certain conditions, it was hard to throw in. The operating lever would slip occasionally, and perhaps strike the operator, raising the bump of profanity. At other times one of the gears would strip, but as the mechanism was not used frequently those tricks caused but little hardship. And yet, slight as this hardship was, it was enough to condemn the tumbler and banish it whenever there was a chance to get a good substitute. Spur and bevel gear reverses were used, first with positive clutches, and lately with friction clutches. The friction clutch came in favor because it would slip and thus avoid shock. Sometimes it would avoid shock to such an extent that it would slip all the time. This brought some manufacturers up to the point of placing friction clutches on the market that would not slip at all. I am inclined to think that in the latter case the slip is in the advertisement; for, if a non-slipping friction clutch fills the bill, a positive clutch fills it equally well. A real good friction clutch is one which allows enough slip to avoid shock, but which does not slip when doing its legitimate work. However, this is really not to the point.

Since mechanics have begun to find out the shortcomings of the tumbler gear, this gear has done some business of its own and secured for itself a solid footing in modern tools thru a new guise. It is now known as the sliding gear, meshing, by means of an idler, with a cone of gears; in other words, it is the familiar rapid-feed speed-changing mechanism. It may have been easy to banish the tumbler gear for reversing it; it is not so easy to do away with it where it accomplishes the change of speed of a shaft. Witness the many hundreds of patents of speed-changing devices, all based on the sliding pinion and the cone of gears. Like all other things, this device has its peculiarities which should be understood if one wishes to use it to advantage. One of the difficulties one meets in the reversing tumbler is that it is often very hard to throw it in one direction, tho it may be easy enough to throw it in the other way. Not only does this behavior of the tumbler make it difficult for the operator, but if the operator is strong enough to overcome the resistance he often succeeds merely in stripping the teeth off the tumbler gear.

ACTION OF THE REVERSING TUMBLER.

Fig. 1 shows why the tumbler acts this way. A is the driving and B is the driven gear of the system; C and D are the idlers. These latter gears are pivoted on a plate (the tumbler), which turns on the same center as B. The arrow shows the direction in which A is supposed to move. A few teeth of the gears A, C and D are represented by lines projecting from the pitch circles of the gears. If we suppose gear B to be held rigidly, say by clamping it, then the projection on A, striking the projection on C, tends to move this projection inward; that is, toward the common center line of A and B. It cannot do this, however, without giving gear C a left-handed motion, and this would cause gear B to move left-handedly. As this gear, however, is locked, gear C cannot move and something is going to break. In practise such conditions do not exist as gear B is not locked. But this gear is supposed to drive some load, and whatever resistance there is against driving, that much resistance must be overcome when throwing in the tumbler. If we suppose, for the sake of illustration, that gears A and B are of the same diameter, then these gears will have the same angular velocity after the tumbler is thrown in. As long as the tumbler is not quite in its place, however, these speeds are not necessarily the same. Imagine, for a moment, that gear C is locked so that the entire tumbler with its gears must turn around the center of B; then the angular velocity of shaft b is much less than that of shaft a; that is, in ratio of $a\,p$ to $b\,q$. Not until gear C begins to turn around its axis does the strain on its teeth become greater. As any part of a mechanism always moves along the path of least resistance it follows that gear C does not get motion about its axis until the tumbler is completely thrown in. To summarize: When the tumbler is thrown in, so as to bring gear C into action, the operator will be assisted by the action of the gear teeth; in other words, the tumbler pulls itself into place, the strain on the gears is much less than that caused by the full load, and the load is started at a much diminished speed; all this keeps on until the tumbler is in position and the gears are fully in mesh. The strain on the teeth then tends to hold the tumbler in place.

If, however, the tumbler is thrown from left to right (all other conditions being unchanged), something entirely different happens, as will be seen by following the diagram again. The tumbler is thrown in from left to right, and the tooth on A striking the tooth on D forces this back to the left. The operator must overcome this resistance, and by holding D in contact with A allow the gear A to start the shaft b. Imagine for a moment that he succeeds in holding the tumbler in the required position; then it will be seen that shaft b must at once start up with its ultimate speed; but this is not all. If shaft a were standing still and the operator were trying to throw in the tumbler he would have to start up shaft b and thus overcome the load. The resistance is at the tooth and his effort at the handle. The distances from these two points to the center of B determine the amount of effort to throw in the tumbler. Thus it will be seen that he has to start the load with an unfavorable leverage, and that the driving shaft must start the load with a speed even greater than the ultimate speed. This explains why the tumbler throws in easy one way, and why the operator must hold back; while the other way the tumbler offers great resistance and the tumbler gears are liable to be stripped. The above analysis is not quite correct and the necessary corrections will be made later. It may serve, however, to introduce the subject.

By reversing the direction of shaft a, C becomes the side which makes the trouble, while D is easy to throw in. In all other respects the case remains the same.

PIVOTING THE TUMBLER AROUND THE CENTER OF THE DRIVING SHAFT.

The tumbler shown in Fig. 1 was pivoted around the center of the driven shaft. Somewhat different conditions prevail when the center of the driving shaft is used as the pivot as in Fig. 2.

In this case B is the driver, while A is the driven gear. The arrows indicate the directions of rotation. It is easily seen that neither gear C nor gear D can be thrown in without trouble. By reversing the direction of B, however, either gear may be thrown in without trouble. This latter arrangement therefore should be recommended for reversing tumblers, but for one consideration: Gears C and D would run as long as the driver is running, while with the tumbler pivoted on the driven shaft they would run only while doing duty. It is of course always desirable to have as few gears running as possible, tho this point may be overlooked where something substantial can be gained.

Tho the tumbler gears may be arranged so as to be thrown in with ease, or rather, tho one may expect this to be the case, one will find, occasionally, that something is the matter with the theory. Tho gear C (see Fig. 1) ought to go in without trouble, it is likely to cause disappointment in this respect. As always, this is not

because practise differs from theory, but because the theory is not complete.

THE LINE OF ACTION.

In Fig. 3 three gears are shown: *A*, the driver; *B*, the driven gear; and *C*, an idler connecting *A* to *B* and pivoted around *A*. A part of a tooth of *C* is shown bearing against a part of a tooth of *B*. The teeth are supposed to be of the involute type, being cut with cutters of the Brown & Sharpe system—that is, the system based on a rack tooth with straight sides, and inclined at an angle of 14½ degrees to the normal. In this system the line of action of the tooth surfaces is a straight line making an angle of 14½ degrees with the common tangent of the pitch circles. The pressure exerted by one tooth on the other is along this line. *X*—*Y* is this line of action in the diagram. The arrows show the direction of rotation of the three gears. The gear *C* is supposed to pull itself into action according to the foregoing. Looking, however, at the direction of the line of action, this becomes somewhat doubtful. In the diagram this line intersects the line *b*—*a* between the points *b* and *a*; and the pressure between *C* and *B* tends, therefore, to bring these gears in mesh. A slight variation, however, in the relative positions of the centers, might bring the line *X*—*Y* outside the point *a*, in which case this pressure would tend to throw the gears *C* and *B* apart.

If the line *X*—*Y* goes thru the point *a*, the tendency is neither way. This would be the ideal position for the tumbler gears, as they would be easy to throw in and to throw out. It must not be forgotten, however, that this condition prevails only when the tumbler gears are fully in mesh, and that it will take some effort to throw them in, this effort diminishing when the gears go deeper into mesh. Where a tumbler gear has to mesh with a cone of gears, and where, consequently, it has to take different positions, only one position at the best can be so favorable. It is possible, however, to select the centers so as to make the idler go freely into mesh with all gears. All that is necessary is that all lines *X*—*Y* should intersect the line *a*—*b*; that is, the line of centers of driver and driven gears between the points *a* and *b* as in Fig. 4.

Suppose I should take gear *B* and circle it around gear *C* and toward gear *A*; then it would at some time reach a position where the line *X*—*Y* will fall outside the line *a*—*b*. This position of the gear *B* is indicated by *B* 1. This fact that the pressure is along the line of action and not along the common tangent causes some disappointment once in a while. On the other hand, it is sometimes the cause of agreeable surprise. Fig. 2 shows such a case. *A* is again the driver, *B* the driven gear, and the tumbler pivots around *a*. The line of action *X*—*Y* is in such a position that the pressure of the teeth tends to pull *C* into action, tho one would have expected the opposite to be the case by looking at the common tangent of *B* and *C*.

CALCULATING THE STRAIN ON THE DIFFERENT PARTS.

One gets a new set of conditions by pivoting the tumbler around the driven gear, but one can determine beforehand what will happen by following the same method of reasoning as used above. Knowing the load, the sizes of the gears and the relative positions of the centers, one can also figure the strains on the different parts and the amount of effort required at the end of a handle of given length. It is not my intention to follow my subject to the end, or rather to the different ends it may lead to, but it may be well to give an example how to figure the main elements.

In Fig. 6, *A* is the driver, *D* the driven gear, and *B* the idler. The tumbler pivots around the driver. The angle *C B A* is supposed to be 90 degrees. Gear *A* has 25 teeth, *B* has 35 teeth, and gear *D* has 30 teeth, all 5 pitch. From this we find that *A B* = 6", *B D* = 6½", and *B C* = 3½".

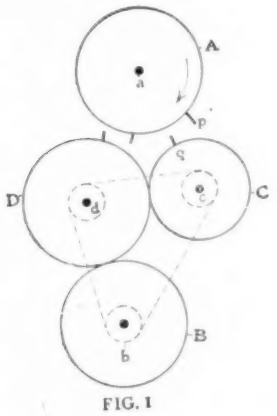


FIG. 1

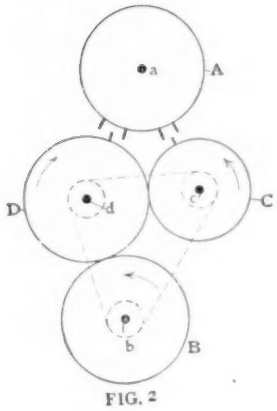


FIG. 2

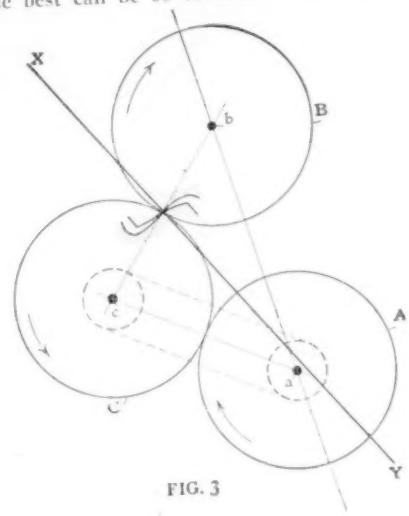


FIG. 3

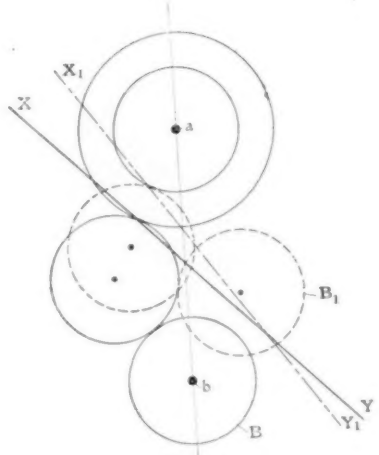


FIG. 4

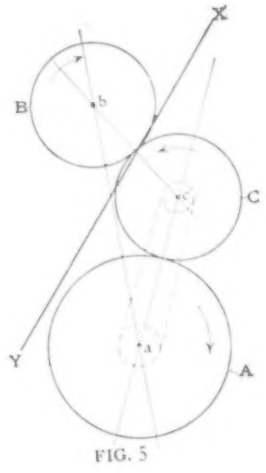


FIG. 5

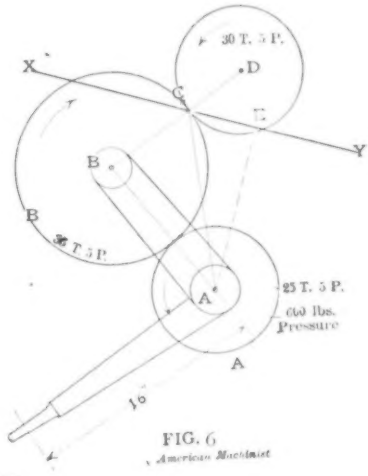


FIG. 6
American Machinist

DIAGRAMS OF VARIOUS ARRANGEMENTS OF TUMBLER GEARS.

We find in triangle ABC that $AC = 6.94''$, and that angle $ACB = 59° 45'$. The direction of rotation of the gears being as shown by the arrows, line $X—Y$ represents the line of action, making an angle of $104° 30'$ with BC. Angle ACY is therefore $104° 30' - 59° 45' = 44° 45'$. We can now find the length of line AE, which is drawn perpendicular to line $X—Y$. $AE = AC \times \text{sine } ACE = 6.94 \times \text{sine } 44° 45' = 6.94 \times 0.70401 = 4.886$. The pressure at the teeth of the driver is supposed to be 600 pounds, and consequently this is the pressure at the point C. The moment of this force and lever arm $AE = 600 \times 4.886 = 2928$. Taking the length of the handle to be 16 inches, it follows that the pressure at the handle will have to be 183 pounds in order to hold the tumbler in place.

If the rotation had been the opposite from the one shown in the diagram, angle ECB would have been $75° 30'$, and therefore angle $ACE = 75° 30' - 59° 45' = 15° 45'$.

Following the same line of computation as before, we would find the required pressure at the handle to be 70 pounds.

Many interesting combinations of tumbler gears can be developed when keeping the foregoing in mind; and, what is almost equally important, many combinations will be found to be impracticable. As it is cheaper to find what is impracticable before it is attempted than after, I think this analysis, tho incomplete, may have some value to the designer and tool builder.

There is one little point which was not mentioned, but which nevertheless should not be lost sight of. I spoke of pivoting the tumbler around the driver, or around the driven gear. Either way may have its advantages; but, where the tumbler is of the nature of a sliding lever (as in the well-known Hendey-Norton feed), there the tumbler should be pivoted around the driving shaft, as it will be very hard to slide the lever along a shaft which is standing still.

We hear much about forging to the front, taking time by the forelock, seizing the bull by the horns and the like, and also that the man with the tail-hold is entirely ignored. Nine men out of ten wisely follow, and succeed, where one does who charges around at the front all the time. If you miss the forelock, seize the tail. It is the hanging on more than the particular hold that counts. The man will go just as fast and nearly as far who has hold of the tail as the one hanging on to the horn; besides, he can hold on better and is in less danger. Young man, don't be too anxious to get rapidly to the front, but hang on to what you have and you will get ahead in the world just as fast as you deserve.—*The Sedgwick Pantagraph.*

A non-corrosive flux for soldering is made by dissolving rosin in alcohol.

New Method of Drying Large Molds.

BY HENRY BIEGEL.

The method of drying large molds, commonly called skin drying, is a factor in foundry practise which is of great importance in the successful turning out of smooth, sound castings. Not infrequently it is necessary to dry molds for castings, such as engine frames, bed plates, main bearings, etc., weighing as much as fifty tons.

When a mold is not properly dried the result upon the casting itself is at once apparent. It will be either strained, scabbed or buckled. In order to avoid these difficulties the heat must be so distributed as to maintain the temperature at as uniform a degree as possible, in all parts of the mold.

Where the heat is too intense, especially when the mold is still green, there is apt to be developed a defective place in the casting, for the reason that such heat will drive the moisture back from the surface of the mold in the form of steam and, there being no opportunity for it to escape this vapor will push the surface of the mold outward, slightly indenting the casting. This is particularly the case with reference to the facing sand, in portions of which pockets may be formed where gases accumulate while the mold is being poured. As the metal rises to the level of such a pocket, the gases ignite and consequently an explosion takes place, with the inevitable result upon the casting.

Drying molds with charcoal has been the practise for many years, but it should be done away with wherever drying is done to any great extent. It not only leaves the mold in an unclean condition but is expensive compared with the use of a stove such as that shown in Fig. 1 which is in constant use at the West Allis (Milwaukee) works of the Allis-Chalmers Company. This stove has been employed in all kinds of work and its use found to be the best and most economical process. It will be seen that the stove is simply a round casting lined with fire-brick and having a fan and motor attached Directly in front of the fan is a small channelway which enters both ends of the stove. The blast goes over and also passes thru the fire, thus blowing it and heating the air for the mold. Suitable dampers provide for dividing the blast between the two channels. On the opposite side of the fire-box from the channelway may be seen another chamber. The hot air passes into this chamber, which is also lined with fire-brick, at the top of the stove.

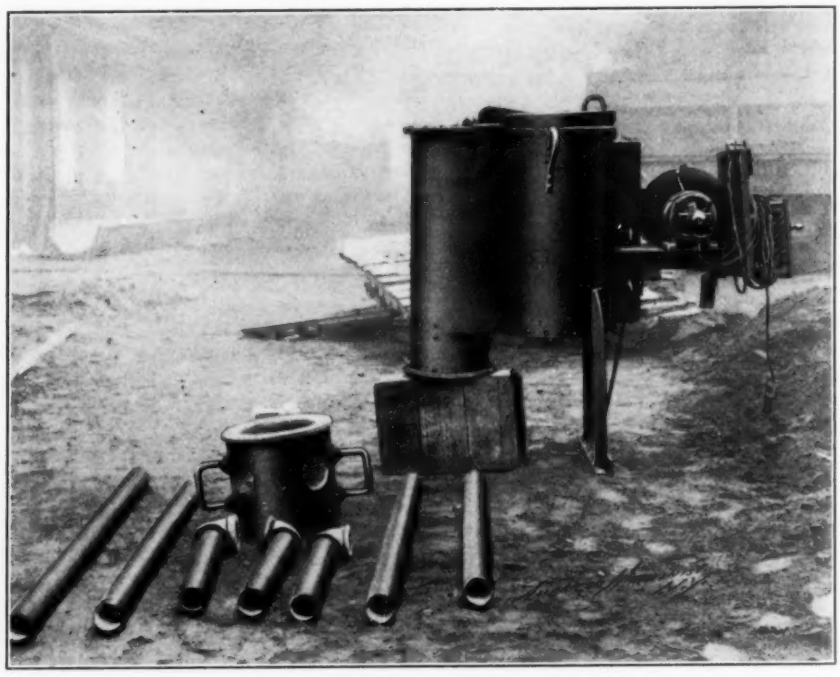


FIG. 1. STOVE FOR DRYING MOLDS.

The stove can be fired with either hard or soft coke. The round pot seen on the floor beside the stove in Fig. 1, which is also lined with fire-brick, is used to distribute the hot air to the mold, the holes in the side being large enough to allow pipes to be laid at any angle desired. After the pipes are inserted, the joints are sealed with loam.

Fig. 2 shows a number of stoves and the utensils used in connection with them, the number of them giving an idea of the extent to which they are employed.

By this process, molds representing heavy castings, say from 12 to 15 tons in weight, can be dried in 10 hours, while those of the larger size require from 15 to 20 hours. When it is considered that both the cope and bottom are being dried

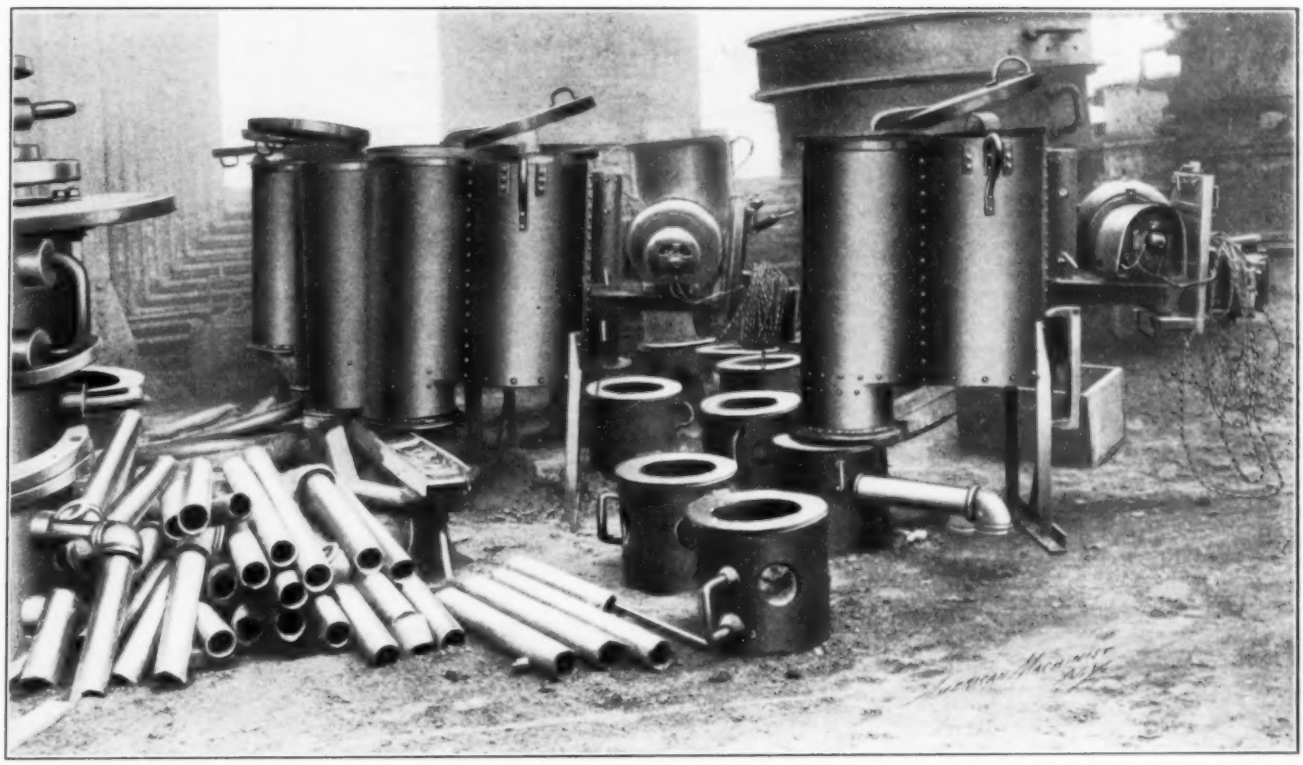


FIG. 2. A COLLECTION OF STOVES AND THEIR EQUIPMENT.

at the same time, the advantage is manifest.

Fig. 3 shows the cope of an engine bed piped up ready for the pit. At the places in the cope where entry for the hot air must be secured, it is necessary to ram up a short piece of pipe, somewhat larger than the pipe used for distributing the air. This is done to protect the cope when the pipe is passed thru, and also to shield it from contact with the latter when heated. The length of pipe must be governed by the depth of mold. It should be kept at about 12 inches from the surface. Fig. 4 shows everything in readiness for drying.

Fig. 5 illustrates the manner of drying the molds on the floor, entry being given

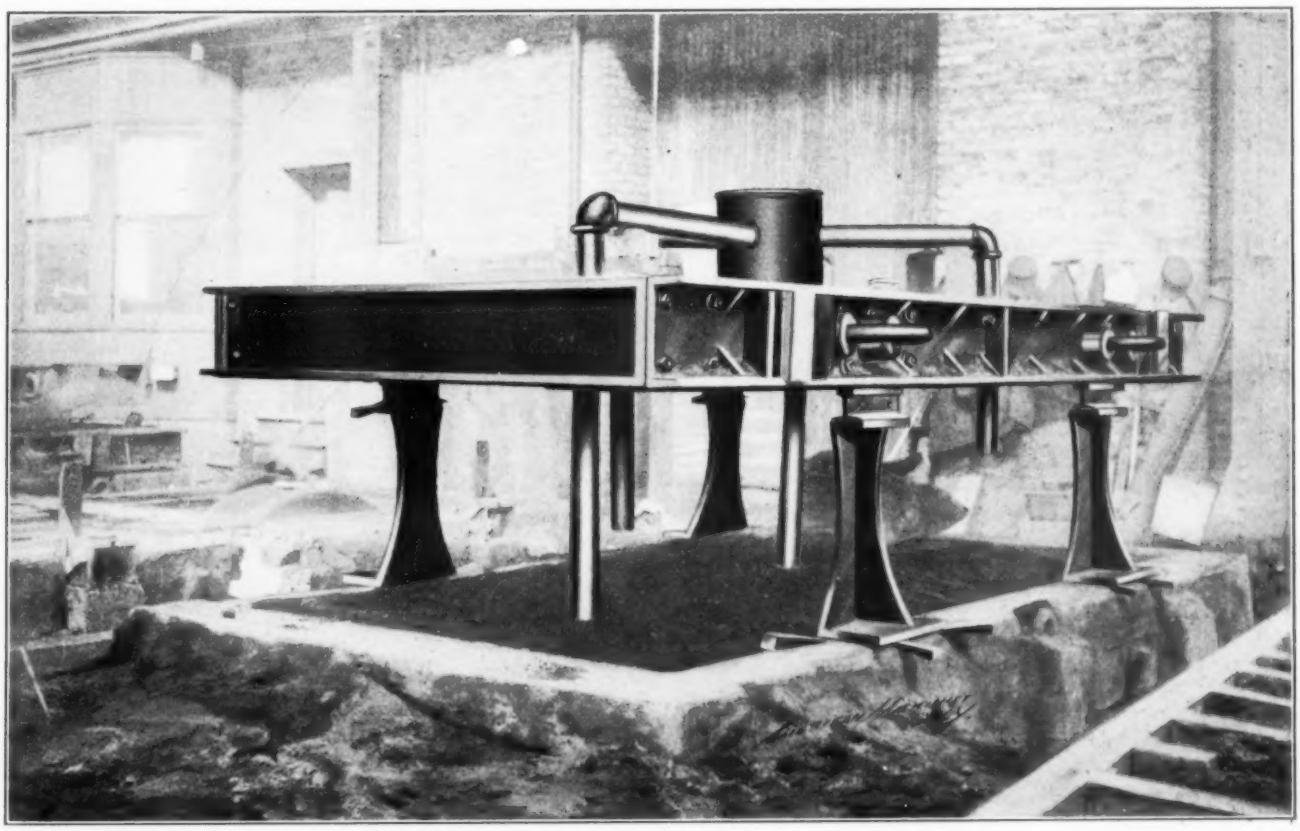


FIG. 3. AN ENGINE BED COPE PIPED UP.

to the heat wherever it is likely to be the most effective in its operation.

If the mold is so constructed as to permit of doing so, it is best to allow the heat to enter at places where the molten metal does not come in direct contact, as for instance, core prints. In that case the place of entry does not have to be made up.

When a fire is started, the stove should be left open until combustion is well under way. This will allow the gases which would otherwise accumulate in the mold to burn off gradually, thus lessening the danger of explosions.

A novel explanation to account for lack of business has been sent in to a Chicago jobber from the great Northwest. "The farmers are not buying because they have money." Was there ever such a reason given before? The letter states that all thru the Northwest thousands of mortgages have been canceled in the last few years and this year, for the first time in their lives, the farmers have bank accounts. They are playing with them, trying to see who shall get the biggest; every dollar they can scrape goes to pile up the bank account, and the tradesmen are suffering from this saving. "The farmers are not buying, because they have money." Holy smoke! This is nearly as good as the story of the Southern farmer who burned his cotton to increase the price.

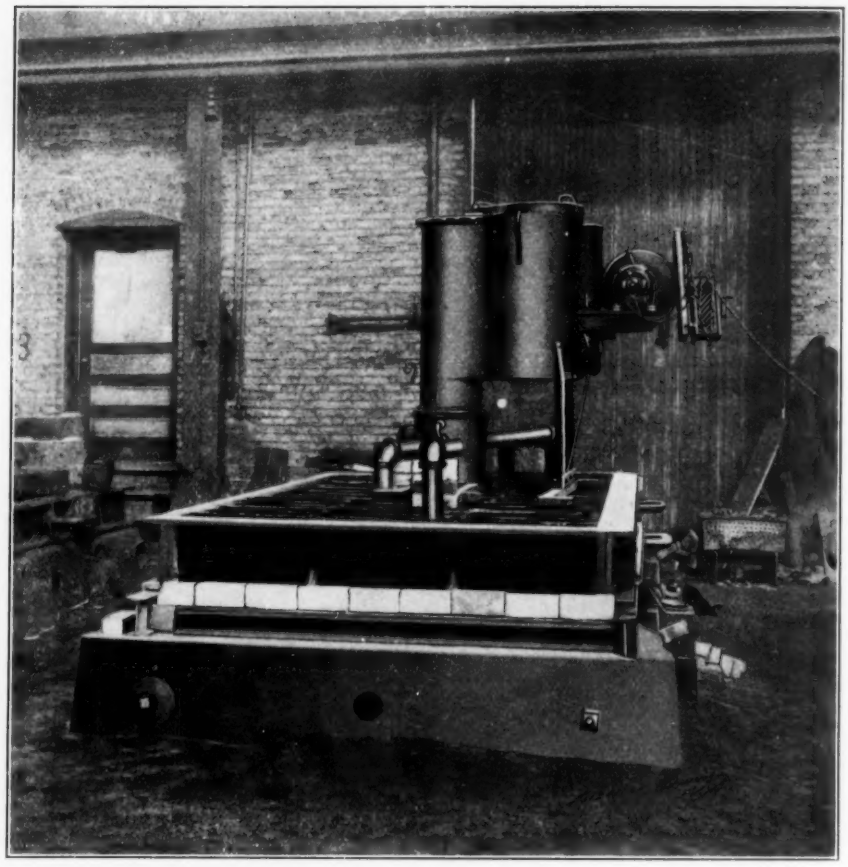


FIG. 4. THE STOVE IN OPERATION.

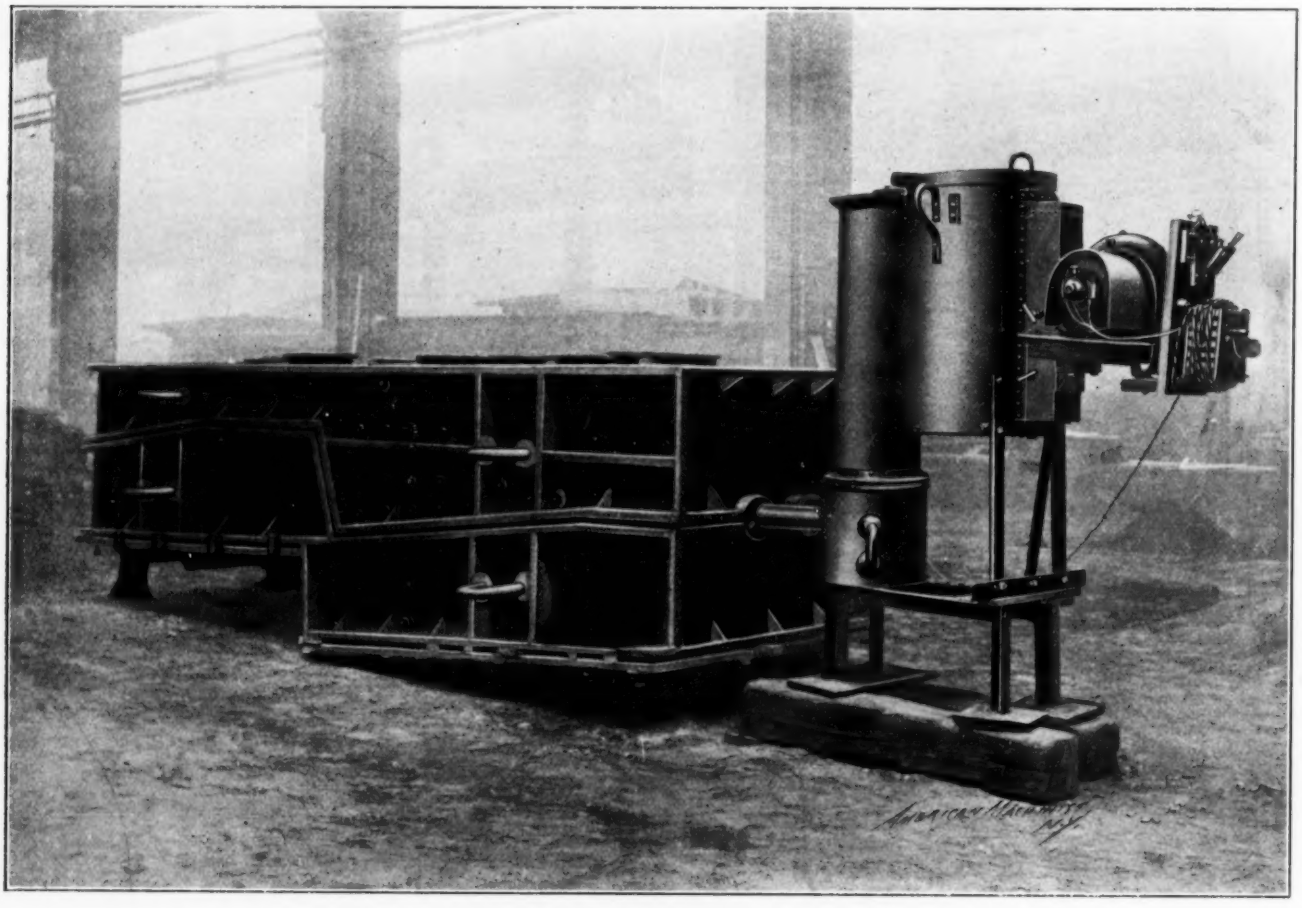


FIG. 5. ANOTHER METHOD OF CONNECTING THE STOVE.

Dies for Making and Driving Double-Pointed Tacks.

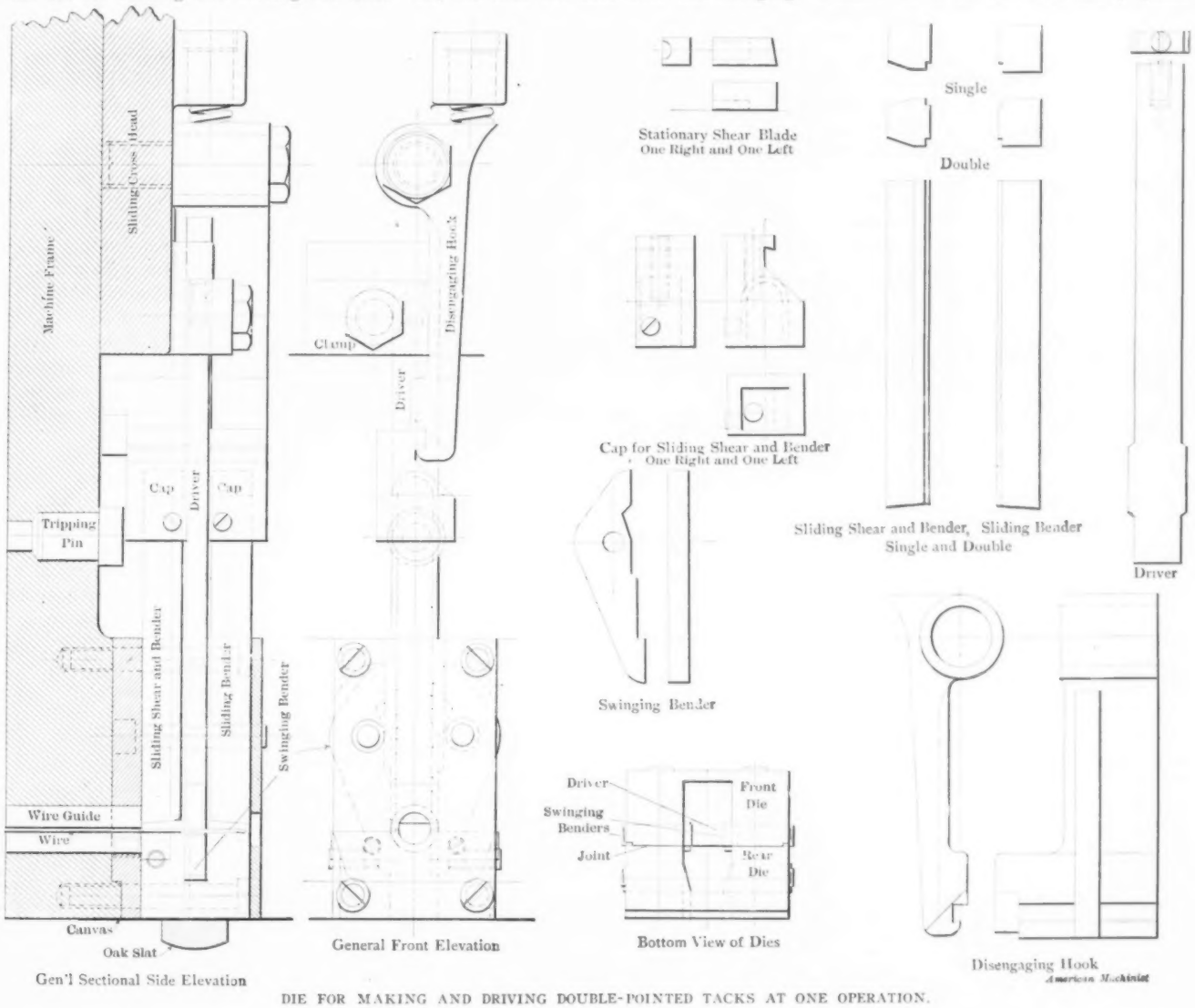
BY S. A. WORCESTER.

Some months ago I had occasion to design a machine for making and driving at one stroke twenty-seven double-pointed tacks in a row. The tacks were to be made from a coil of flattened wire and driven thru a canvas belt into an oak slat, the points coming thru the slat and clinching smoothly. These canvas belts with their oak slats are used on harvesting machines. The vital part of the machine is the die for making and driving the tack. Two different widths of canvas and lengths of slat were used and the dies at the ends of the row each made and drove two tacks about 9-16 inch apart, while the other twenty-three dies made and drove but one tack each.

Before making the full set of twenty-five dies one experimental double die was made with a cheap device for running it, and it was tested for durability and satisfactory operation by making about 3,000,000 tacks, several thousand of which at different times of the test were driven thru oak slats and canvas. At the close of this test the dies appeared to be good for at least 3,000,000 more tacks before any sharpening would be necessary. No defective tacks were made, except a very few which were caused by short kinks in the wire.

The complete apparatus consists essentially of the rear and front dies, the sliding shear and bender, the sliding bender, the swinging bender and the driver, all as here shown in general elevations and in details. The two flattened wires, which are fed into the die from the rear side, lie over the swinging benders, so that when the sliding shear, descending, cuts them off, the ends are bent over the swinging bender by the sliding bender and the shear and bender which are forced down together by the disengaging hook on the crosshead of the machine. When these two benders have completed their stroke, which brings their lower ends flush with the bottom face of the dies, the tripping pin, striking the beveled surface of the disengaging hook, disconnects it from the caps, which are not further affected by its continued downward travel.

About this time the lower end of the driver, whose upper end is positively clamped to the crosshead, is pushing the completed tacks downward. The enlarged portion of the driver when in its upper position, as shown in the front elevation, holds the upper ends of the swinging benders outward and the lower ends in position for bending the tacks. In descending, after the shear and benders have completed the tack, this enlarged part of the driver forces the lower ends of the swinging benders out of the tacks and clear of the descending driver. The tack is positively guided in bending and in driving until it is clinched, by the corner grooves in the shear and bender and the sliding bender. It is so well and firmly guided that it will drive into oak knots without any difficulty, and without breaking or doubling the tack. On the return stroke of the crosshead the disengaging hook takes hold of the caps and draws back both sliding benders so as to clear the entering wire, while the returning driver throws out the upper ends of the swinging benders, bringing the lower ends again into position for bending the tacks. The stationary shear blades are held in position endwise in the rear die by the set-screw in the half-round groove. The rear die is threaded to fit this set-screw, but the shear



DIE FOR MAKING AND DRIVING DOUBLE-POINTED TACKS AT ONE OPERATION.

blade is grooved to fit the outside of the screw. The stationary shear blade is held sidewise by the set-screw in the back of the rear die.

The single dies for making one tack were made with but one shear blade and one swinging bender, and the driver had the projection for operating the swinging bender on one edge only. The rear die is shaped, of course, to fit the single shear and bender. The machine makes one revolution at a time, like the ordinary power press, stopping always with the crosshead at the upper end of its stroke and the parts in position to allow another length of wire to be fed in. The slat and canvas are held up firmly against the bottom face of the dies by a tempered steel bar curved to fit the slat. All important wearing parts were made of Styrian tool steel, carefully hardened and tempered.

Boiler Manholes Too Small.

We remember a case of an inspector who with some little difficulty managed to enter the drum of an elephant boiler. After completing his inspection he tried to pass out feet first, as he could not turn around in the restricted space, but found this more difficult than he anticipated. Endeavors were made to free him, but each time his clothes crumpled up and blocked the way, and it was only by hacking and cutting off his clothes, which took some considerable time, that he was liberated in an exhausted condition. Another case occurred only a few days ago. In this instance an engine fitter, employed by the North-Western Railway at Crewe, was repairing a locomotive, when he had occasion to get inside the water tank, the inlet of which was exceedingly small. He got in with little difficulty, but found he could not get out. The efforts of other workmen to extricate him were unavailing. He became exhausted and lay in the tank unconscious. A number of mechanics had to be summoned, and the engine was taken to pieces before the unfortunate fellow could be released, when it was found necessary to take him to the hospital.—*Mechanical Engineer*, London.

How many kinds of insurance are there? Here is a Western agent's list, which may or may not be complete: Fire, life, safe, rents, theft, credit, patent, marine, tornado, accident, burglary, sprinkler, lightning, plate glass, transportation, tourists' baggage, bank and messenger, robbery, tailors' and furniture floaters', physicians' and druggists' liability, travelers' samples, fidelity, official, guaranteed attorneys' department, contract, judicial and court bonds, teams, health, postal, elevator, casualty, flywheel, leaseholds, automobile, contingent, steam boiler, landlords' liability, workmen's collective, liquor dealers' license, general liability, hold-up insurance, bank accounts.—*Insurance Press.*

Grinding.

BY B. A. CHATHAM.

The correspondence on this subject, in addition to its educational value, often gives evidence of a refining influence where grinding has been introduced.

GRINDING CORLISS VALVES.

Thus Mr. Henry is curious to know why his valves don't grind straight, and tho the error may be of no material importance in this particular case, it would probably have passed unnoticed or have been disregarded if it had been machined by a method where close measurements are more the exception than the rule. Curiously enough, I had heard a similar complaint from three different operators who were unknown to each other and in the only opportunity personally experienced in grinding such a valve—the exhaust pattern—the same thing appeared, tho the measuring tools used were such as did not register the amount of error. The impression was that the sag of the piece—which measured 9x4x3 inches—was the cause, and tho this by reason of gravity would be in a vertical direction, the tendency for this sag to be inclined in the direction of its motion or toward the wheel, would be enough to cause the error mentioned; Mr. Henry gave no definite dimensions, and this reason may not apply, but it may be

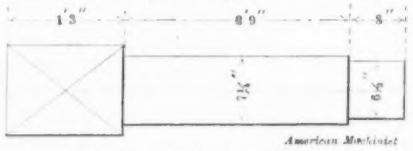


FIG. 1. WORK TO BE GROUND.

that the error is more apparent than real and the small place may be merely at the points where only is it possible to take dimensions. In grinding gray iron there is always a tendency for the wheel to cut deeper where the resistance is the least bit prolonged, and in this case meeting and leaving the broken edges of the casting would probably cause more to be ground from these points; this may be easily illustrated in the grinding of any piece of gray iron, for if we let the wheel run over the end without relieving the pressure of cut, it will score the work and cut deeper when some fraction of its width has passed the end. If opportunity offered I should make the test of making a pair of valves a close fit and after tapping thru their respective holes note the marking.

With reference to the first assumed cause the error is unavoidable, but if the latter the trouble may be minimized by keeping the wheel perfectly free cutting, tho this will mean repeatedly truing with the diamond.

GRINDING GRAY IRON.

The trouble in grinding gray iron is that it dulls the grit of the wheel very quickly and glazing commences; after this no grinding is possible, and the action of the wheel is merely that of polishing until enough pressure is exerted to break the face of the wheel. It must be understood that in all this reference is made to finishing only and what is meant to be conveyed is that a wheel of any grade will act in this manner on gray iron, more especially if chilled, and is somewhat opposite to what takes place in finishing steel. In finishing steel there is a point reached where the wheel will act in the same manner—that is, it will glaze and the length of time for which it is effective depends on the texture of the material ground. With hardened steel the period of efficiency is about the same as for gray iron, but for soft machinery steel it is considerably longer, and I also find this further difference: With steel you can break the dulled surface grit away by an increased work speed and so get the wheel sharp and in serviceable condition again, but with gray or chilled iron this remedy doesn't apply even with a wheel so soft as a Norton "J." It may be as an argument opposed to this, that a still softer wheel should be used, but there seems to be a limit to this if a passable finish is to be obtained, because a too free-cutting wheel, or one whose grit is constantly being replaced, will scratch the work.

GRINDING CHILLED ROLLS.

A recent experience in grinding chilled rolls may have something in common with Mr. Henry's valves. They were mounted on steel spindles and required to be "light tight." Three separate individuals who have had many years' experience in grinding and supervising this class of work have assured me that they find and have got to consider it an impossibility to attain this accuracy mentioned by automatic means; their practise is to grind the rolls by trial—that is, they place them in contact on a suitably constructed frame and note the points where they touch, afterward reducing the diameter at those points. They do not use a master roll, which would seem to be desirable, but make them in pairs and they claim it to be the only possible method, altho the ways of the machine used may be quite true; neither do they profess to know or to have found any reason for it. It would be interesting to know if a similar difficulty is experienced on your side of the Atlantic, or is it only a question of wheels which, if truly cutting and not merely rubbing, would seem bound to copy on the work ground the alinement of the ways. In the personal experience mentioned the attempt to grind the roll by automatic traversing was a failure, but the reason for this seemed to be that the machine did not grind straight, as was proved by the test suggested by Mr. Norton.

COST OF WHEELS.

Perhaps there is no greater retarding influence to the adoption of grinding processes than the feared cost of wheels, tho that this need not be considered if they are used intelligently may be gathered from the following experiences of a Norton plain grinding machine.

We grind many pieces, especially shafts

and screw blanks, without any previous turning, merely straightening the stock and centering and facing in the Jones & Lamson turret lathe, and have adopted this system because we found it more economical to grind right out than it was to rough-turn first. In addition to the labor involved in the lathe in the actual turning we had to re-straighten the pieces before they could be ground and there were other expenses incurred which are difficult to estimate, as they refer to transport and clerical work involved where operations are multiplied. Further than this, we found after experiment that the amount of stock in the rough bar, instead of being an item of extra cost in the time for grinding, was really an advantage to the operator, as he could attack the piece with confidence and with the knowledge that there was no excessive caution requisite, as is the case where previous labor with its attendant mistakes has been incurred. These of course are in the shape of low places in the diameter and were a sequence of the cheap labor employed in rough-turning. We have found, in common with others, that to make an actually universal table of feeds and speeds for our grinding department would be a big job, but are satisfied that we are gradually getting valuable data to work upon for much repetition work.

DATA ON GRINDING.

For instance, we have numerous pieces of cast steel to grind 1½x10½ inches; we used a 24-M Norton wheel and found that by running the work at 35 feet per minute with a table feed of 8 feet per minute and a cross-feed of .003 inch per traverse, the wheel wore .0045 inch in removing .045 inch, which was the amount that had to be removed; we reduced the speed till it reached 18 feet per minute with same table feed and with cross-slide feed of .002 inch per traverse; when we found the wheel wore only .001 inch and the time consumed was 30 seconds less than with the previous speed. We found that at the higher speed the wheel would still show bright sparks for a longer period after feeding had ceased than was the case with the lower speed. We tried a still slower speed, but the wear of wheel being the same and the table feed having to be reduced to suit the reduced work speed, the time was 4½ minutes as against 4 minutes for the next previous record, and this being considered the best combination for that diameter of material, we adhere to it. The most economical combinations for other diameters are arrived at by similar methods, and tho a change of wheels, or a new line, would possibly upset all our data, the short time required for repeated experiment would be well repaid. We use a large number of circular dies, and these are made from cast-steel bars in 10-foot lengths; the black stock is ruled straight and centered and we grind a length in 45 to 60 minutes, removing 1-16 inch. No elaborate finish is required, but they must be straight within .0005 inch and the bars are 1⅝ and 1⅞ inches diameter. Bars of spring steel for use in our automatics are ground in 8- and 10-foot lengths, as we find it cheaper to buy black stock and grind than it is to buy drawn stock. We remove about 1-16 inch and allow a limit of .002 + and — and the time varies from 30 to 45 minutes; the smaller size bars taking the longer time on acount of their flexibility; these are 9-16 inch by 9 feet. With long machine shafts where reductions at the end exceed one-eighth of the main diameter, advantage is taken of the turret lathe when they go to be centered and they are turned to shape, leaving 1-32 inch to be removed by grinding. After being ground they are returned to have shoulders squared and ends threaded when necessary.

NO SHORT KINKS.

We find that the main thing to insure economy of wheel and also rapidity of work is to have the black stock as free from short kinks as possible, for when these are present they wear the wheel excessively, and also necessitate traversing over a portion of the piece cutting wind until

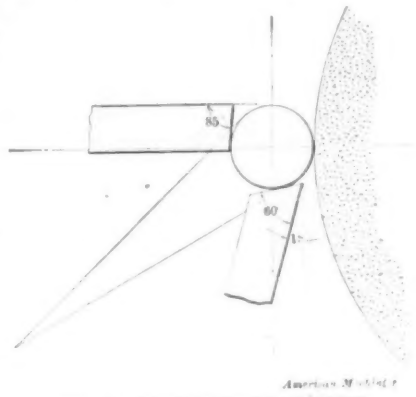


FIG. 2. ARRANGEMENT OF RESTS.

they are ground down. Previous to our recognizing this, we had much trouble with the pieces springing on account of the heat generated with the heavy cut at these points. Some skill with spring calipers is essential to control the diameter while the piece is running, as much time may be lost by stopping the work and going from end to end with the micrometer. We spring the shafts up from the middle when setting the steady blocks, tho only an amount that is judged sufficient to prevent undue vibration; having found that the higher the middle of the piece is above the center the more liable is the wheel to cut with its edges when reaching the ends with consequent feed lines to mar the finish. We rough down to within .002 inch over the main body and then rough the ends where other diameters are necessary, afterward smoothing the wheel with the diamond and then proceed to finish. Those portions of any piece which have steadies bearing on them we leave till the last when possible, so that the last cuts over the piece may remove any marks they may be liable to leave. We commence usually by finishing at a slower speed than the roughing one until the finish shows that the wheel has worn quite smooth. After this point has been reached, we generally find that we can increase the speed within certain limits without hurting the quality of finish and thus use a faster table feed. A feed about the full width of the wheel is maintained even in finishing, nor is it ever reduced without feed lines begin to show.

SPLINING.

None of the pieces mentioned are splined the whole length, and at the risk of being criticized I must say that I can't see any advantage gained by splining a long, slender shaft before it is ground. The cheapest way is the best when results can be obtained sufficient for the purpose, and it doesn't seem to me that anything can be claimed in favor of the practise, except that there are no burrs to remove and distortions due to splining are removed. The former may be overcome by a careful man and a smooth file, and the latter by keeping cutters sharp. As a set-off to this, there are various disadvantages. To insure a a true cylindrical form the piece must be supported in shoes or steadies which are of a radius identical with the finished diameter, and if metal shoes are used you must do your previous turning with painful accuracy to avoid leaving too much for grinding. If wooden shoes are used, they must be so proportioned as to insure them wearing and conforming to the decreasing diameter of the shaft, and even when this is attained it is not a permanency because the next time they are required to be used they are likely to be warped so much as to be unfit for use until much time has been spent in refitting them. It was imagined that radial shoes would be required in grinding black stock, but we have found no difficulty in producing true cylindrical work with plane wooden strips. When a piece has proved unround the reason has always been found in either the angle formed by the upper and lower steady blocks, or an error in affixing them. The wooden strips are shaped as shown in sketch with beveled edges, the upper one about 85 degrees and the lower one about 60 degrees; the upper strip is set with its lower edge just below the center rather than above. If set higher than the center, the work will almost certainly be unround, as will be the case also if the angle of the upper strip be too acute. Dotted lines show where this may be the case and the reason seems quite obvious.

PREPARING GRAY-IRON PIECES FOR GRINDING.

In preparing gray-iron pieces for grinding, we find it more economical to turn closer to size than we do with steel; for, altho we can remove the stock quicker, it is at the expense of the wheel, which must be rather soft, especially for pieces large in diameter.

We have not yet been able to get any practical data to work upon for this material, as we find that the wear of wheel is variable, even when a constant feed and

speed are maintained. The reason for this seems to be in the wheel not wearing uniformly true, as is the case with steel, but rather breaks away in patches and gets rapidly out of truth when heavy cuts are taken. We have some gray-iron pillars, shown in sketch, which are square on the end. These were turned in two cuts, leaving .030 to .040 inch for grinding. We tried various wheels, but all wore excessively, the best losing about 1-16 inch of its diameter in grinding one pillar, which was considered too wasteful, tho there was a material saving over the previous method of finishing them right out in the lathe. We have now improved on this by taking the second cut in the lathe at a feed of ⅛ inch with a broad-nosed tool and leaving .015 to .025 inch for grinding. This calls for a little more care in the lathe, but we save this time in grinding and the wheel wears about 1-16 inch in grinding five. We grind one of these pieces in 40 minutes, including handling. We rough all our work at a wheel speed of 6,000 feet per minute and finish steel at the same speed, but we finish gray and chilled iron at 5,000 feet, which speed seems to suit the wheel better for finishing. We find we can traverse over the work a greater number of times at this speed without danger of chatter, and it may be that the lower speed leaves the surface grit effective for a longer period. When chatter marks do appear we re-true the wheel right away, because we find that a change of work speed rarely removes them, as is the case with steel. In finishing the latter material, if chatter marks appear in spite of all precautions that have been taken in the way of steadies and suitable wheel, we find that a change of speed, either higher or lower, will sometimes cause their disappearance. When this method fails we re-true the wheel.

THE OLDER METHOD COMPARED.

The shaft shown at Fig. 3 will serve to illustrate our method of machining this and somewhat similar pieces compared with our previous method, which was as follows: We took a bar of stock 1⅜ inches diameter and turned it in the engine lathe. We used a feed of 20 per inch with a high speed, and the turning occupied 50 minutes, including chasing the thread on the end. Straightening was then required before the piece could be ground and this averaged 10 minutes per shaft. About .020 inch was left for grinding and the time for this operation was 1½ hours, tho occasionally 2½ hours or more were taken thru the springing of the piece, or the necessity of springing the whole body to allow low spots to clean up. We now take stock 1 5-16 inch (which is a saving in weight of raw material) and after straightening it goes to the turret lathe. It is then centered and the smaller end turned 1-32 inch larger than dimensions shown. The other end is merely faced; this occupies 15 minutes. It then goes to be ground, and is first roughed over the 1¼-inch portion and the 1-16 inch reduction is made on the end, .002 inch being left for finishing. It is then reversed and the smaller sizes first roughed to the same limit. After truing the wheel up, these sizes are first finished, the piece again reversed and the 1 3-16 inch part finished, then the main body. It is then returned to the turret lathe, where shoulders are squared and the end threaded, which takes 10 minutes. The grinding of the shaft occupies an average of 1½ hours, but the time is gradually being reduced with the growing skill of the operator. We seldom have a piece spring, nor are hardly likely to have without a change of operators, when the new man will have to be taught first not to burn the work with heavy cuts at any one spot if he wants to avoid springing with its many aggravations. We find that cost of wheel is not to be considered when saving in time is taken into account, and I may say incidentally that two years ago these same shafts (which have to be very accurate) took seven or eight hours, tho that was previous to our grinding them.

WHEELS TOO HARD SPEED TOO LOW.

Paul Wesley in his matter of small grinding, at page 764, is apparently repeating the mistake I formerly made in using too hard wheels and too low wheel speed on small work; he grinds ⅜-inch hard steel with a 70-M wheel, which is just possible it seems, tho personally I never use a wheel harder than L for small grinding machines and seldom vary from a surface speed of 5,000 to 5,500 per minute. I find that the combination of high wheel speed and softer wheels tends to make the wheel last longer and allows a greater variety of both material and diameter of wheel. Thus I can grind ⅜-inch cast steel with 60-L wheel and also 1⅜-inch cast steel, tho I should choose 36- or 46-K for the larger diameter. My reason for choosing a coarser and softer wheel would be because I know that the wheel has a greater area of contact on the larger diameter. I would have it coarser, so that the water used should play a prominent part when the heat is generated and where that partial freezing of the chips, as I take it, causes the wheel to fill up when it is too hard. It would be softer because I know that the said greater contact area means that each particle of grit has more work to do and must the sooner break away when it gets dull if the wheel is to continue to be efficient. The time for grinding tapers referred to doesn't seem to leave much to be desired, and even water might fail to accelerate it, tho it would give a more accurate job. His steadies are lead shoes and I don't favor them, nor do I any metallic ones. To counteract vibration a cushion is more of a requisite than a steady as the term is understood, and wood has always seemed to me the ideal material. Besides being easily adapted, for Paul Wesley's requirements I should imagine that wooden shoes with a light tension spring behind them would stop his chatter marks and would not interfere with the accuracy of taper. One shoe only might be tried behind the portion ground and if not effectual another might be placed close up to the center at the opposite end. His method of driving small bushes is good for work not requiring accuracy, but trusting to the truth of the edge of a hole seems to me like taking things for granted, tho the fact of his using a set wheel for a reduction of .006 seems, to say the least, a remarkable feat.

CHATTER MARKS.

Mr. Wesley's opening remarks about high speed and vibration raise the whole question of chatter marks, as I presume he means to infer the liability of them to appear when he speaks of the necessary high speed. These chatter marks with their sometimes invisible cause and unknown cure are the grinder's greatest trouble, and probably it is only the want of an accumulation of AMERICAN MACHINIST readers' experiences that is needed to solve the problem. I can't say that I am at one with Mr. Wesley in my experience of chatter. I find it more likely to appear with large work and think the reason is for one thing that the main supports of the work, which are the centers, are proportionately smaller in large work than small; they are also more in evidence because the wheel contact is greater. Chatter marks, as we understand them, don't always come from vibration of the work alone: they may come from an untrue wheel, when the cure is obvious. So is the cause usually. They may come from defects in the machine, where the two centers of wheel and work are not constant either from mistaken design or local influence and when we consider how exaggerated small errors are shown in ground work we need not be much surprised at the difficulty of tracing their origin.

A machine which seemed perfect in every way gave trouble in the way of chatter marks and, contrary to accepted ideas, the higher the speed of the work the less were they in evidence. A tube was being ground in the machine, and it being of course hollow the ringing of the wheel was greater than it would be on a solid piece. In taking light cuts there was a distinct intermittent contact denoted by this ringing, and in looking round it was

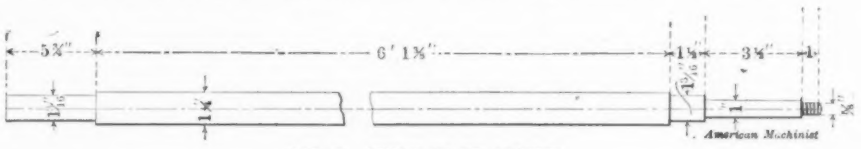


FIG. 3. WORK TO BE GROUND.

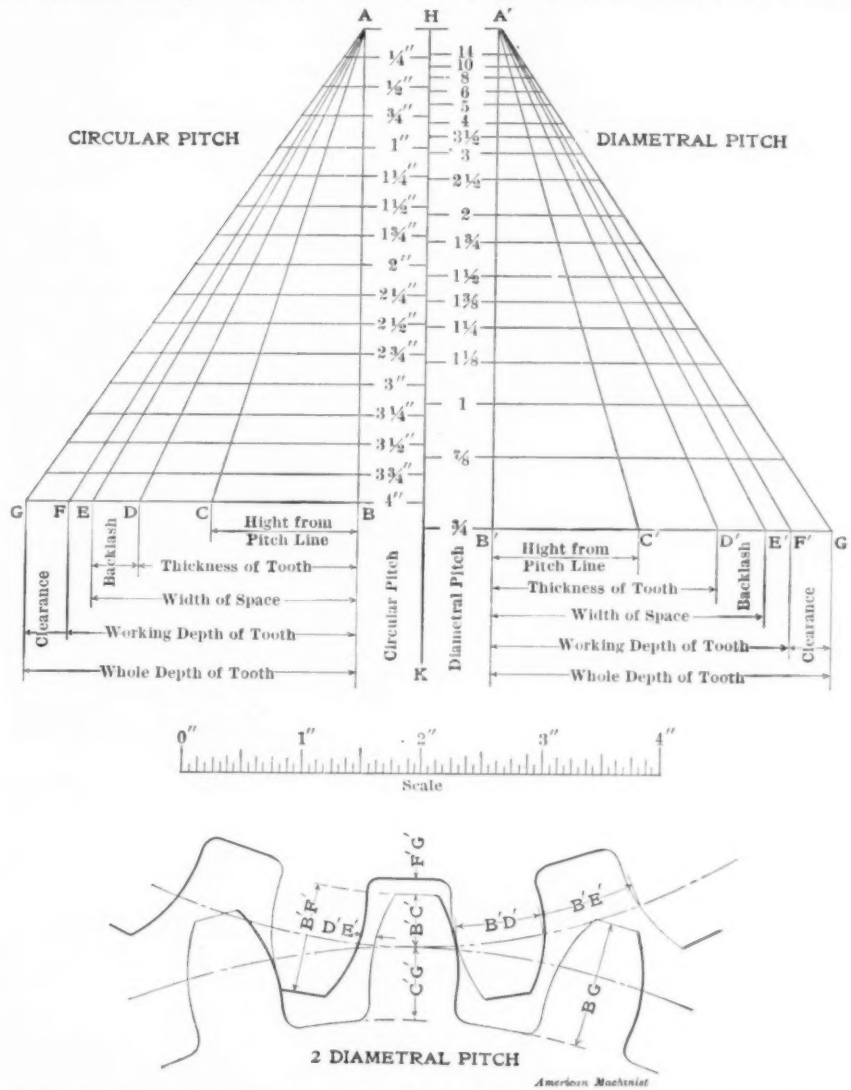
seen that the taps of the wheel on the piece were in unison with the eccentricity of the work driving drum which was untrue. When this was remedied the chatter disappeared. The drive was a very short one and the stretch of the belt was limited; probably a raising of the work drum and a longer belt would have effected the same purpose.

England.

Diagram for Cast-Gear Teeth.

BY G. G. DANA.

The accompanying diagram for laying out teeth for cast gears will be found useful by the machinist, patternmaker and craftsman. The diagram for circular pitch gears is similar to the one given by Professor Willis, while the one for diametral pitch was obtained by using the relation of diametral to circular pitch.



By the diagram the relative size of a tooth may be easily determined. For example, if we contemplate using a gear of 2 diametral pitch, by referring to line $H K$, which shows the comparative distance between centers of teeth, on the pitch line, it will be observed that 2 diametral pitch is but little greater than 1½ inches circular pitch, or exactly 1.57 inches circular pitch. This result is obtained by dividng 3.1416 by the diametral pitch (3.1416 divided by 2 equals 1.57). In similar manner, if the circular pitch is known, the diametral pitch which corresponds to it is found by dividing 3.1416 by the circular pitch; for example, the diametral pitch which corresponds to 3 inches circular pitch is by the line $H K$ a little greater than 1 diametral pitch, or exactly 1.047 (3.1416 divided by 3 equals 1.047).

The proportions of a tooth may be determined for either diametral or circular pitch by using the corresponding diagram.

Continue, for illustration, the 2 diametral pitch. We have found, above, the distance between centers of teeth on the pitch line to be a little more than 1½ inches (1.57 inches). The hight of tooth above pitch line $B' C'$ will be found on the horizontal line corresponding to 2 pitch. The distance between the lines $A' B'$ and $A' C'$ on this line may be taken in the dividers and transferred to the scale below. Thus we find the hight of the tooth to be 15-32 inch. In the same manner the thickness of tooth $B' D'$, width of space $B' E'$, working depth $B' F'$ and whole depth of tooth $B' G'$ may be determined.

The backlash or space between the idle surfaces of the teeth of two gear wheels when in mesh is given by the distance $D' E'$. The clearance or distance between the point of one tooth and the bottom of space into which it meshes is given by the distance $F' G'$. The backlash and clearance will vary according to the class of work for which the gears are to be used and the accuracy of the molded product. For machine molded gears which are to run in enclosed cases, or where they may be kept well oiled and free from dirt, the backlash and clearance may be reduced to a very small amount, while for gears running where dirt is likely to get into the teeth, or where irregularities due to molding, uneven shrinkage, and like causes, enter into the construction, there must be a greater allowance. The diagram is laid out for the latter case. Those who have more favorable conditions for which to design gears should vary the diagram to suit their conditions. This can be done by increasing $B D$ and decreasing $B E$, and by increasing $B C$ or decreasing $B G$, or both, to get the clearance that will best meet the required conditions. The same kind of diagram could be laid out for cut gears, but as tables are usually at hand which give the dimensions of the parts of such gears, figured to thousandths of an inch, it would be as well to consult one of these.

Concrete Mixtures.

The following is from a pamphlet of the Engineering Company of America:

A typical concrete is made as follows: To one barrel of standard Portland cement are added three barrels of clean sharp sand. The two are intimately mixed, either manually or by a mechanical mixer, and then enough water is added to bring the mixture to a certain consistency, the proper amount of water being judged by one experienced in this work. Five barrels of broken stone are then added, the whole thoroughly intermixed, and the concrete thus formed is ready to be conveyed to the forms or the excavations prepared for it. Concrete made in the above proportions would be known as a 1-3-5 mixture. The permissible proportions, however, vary widely, 1-2-4 to 1-5-10, according to the nature of ingredients and the service for which it is intended. In general, concrete with the smaller proportion of cement will not sustain the same strains as the concretes wherein the proportions are about as indicated in our typical mixture.

A watch-crystal trust has been formed in Europe, including firms in Germany, Switzerland and France. Watch crystals are made by hand. The total value of the product of the trust firms last year was $554,051, of which $92,744 worth was exported to the United States from Kehl, Germany. This is not likely to be a very oppressive trust.

The Teetering Effect of Springs.

The graduating thesis of Mr. Thorsten Y. Olsen at Cornell University gave the results of some very interesting experiments on the vibration of springs under load, or, as he calls it, the teetering effect, and of these results, which were previously unknown and unsuspected, we present herewith some of the most striking.

Fig. 1 shows the testing machine as arranged for the experiments. It consists of an Olsen hydraulic testing machine with the addition of an apparatus supported at the end of the main weighing lever for recording the vibrations. The spring is placed on the table of the machine, which is made long, as shown, in order to test plate springs, and is loaded to any desired pressure by the hydraulic pump. The weighing apparatus is disconnected at *A* and from the end of the main lever is suspended a rod to which is hung a plate *B* carrying weights for producing the vibrations. In order to produce the vibrations the lever and weights were raised a prescribed amount—2½ inches—and allowed to drop, when the vibrating effect followed. To record the vibrations a board carrying a sheet of metallic paper was mounted on a support, as shown, and arranged to be driven endwise by a screw at its back, the screw being driven at a prescribed rate by a pulley and belt, a split nut permitting the paper to be stopped, started and returned to the zero position while the screw continued its motion. The end of the beam carried a brass wire which was pressed lightly against the paper by a spring.

Fig. 2 gives the records obtained from a helical spring made of 1.254-inch wire having a mean coil diameter of 5.264 inches and 8.75 coils, the different records being obtained with different loads, as noted on the diagrams. The series of dots below the curves were made by an electric attachment to a seconds beating pendulum, the space between each pair of dots thus representing a second of elapsed time.

The results will be seen to be very curious. In the case of the 500-pound load a series of secondary vibrations appear which become much more clearly defined with the 1,000- and 2,000-pound loads and with the 4,000-pound load they again assume the character shown with the 500-pound load, while, with the 6,000- and 10,000-pound loads, they disappear.

A similar effect is shown in the curves of Fig. 3, which are from a spring of 1.245-inch wire having a mean coil diameter of 5.03 inches and 4.7 coils. The effect in this case is, however, much less pronounced and does not appear at all except under the 10,000- and 12,000-pound loads. The observations are too few in number to justify generalizations, but it seems not unreasonable to suppose that the action depends upon a relation between the length of a given spring and the load applied, shorter springs requiring apparently heavier loads which, if the spring is short enough, may be heavier than the spring can carry.

An action similar to that shown in Fig. 2 for the 500-pound load was found with a spring of 1.24-inch wire, 5.038 inches coil diameter and 4.74 coils under a load of 8,000 pounds and an action similar to that of Fig. 2 under 1,000 and 2,000 pounds was found with a spring of 1.112-inch wire, 3.804 inches coil diameter and 4.18 coils under 2,000 pounds, but diagrams of those are not given.

Experiments were also made with elliptical or plate springs, and Fig. 4 shows the results with a Brill car truck spring. The limited amount of vibration as compared with helical springs is at once apparent and is attributed to the damping effect of the friction between the plates. To test this, this same spring was tested with rollers between the leaves and the diagrams of Fig. 5 resulted.

Locomotive plate springs as used on the Lehigh Valley and the Delaware, Lackawanna & Western railroads were tested, the results from the two springs being shown in Figs. 6 and 7, respectively. The Lehigh Valley springs will be seen to give much less vibration.

Of the significance of the secondary vibrations almost nothing is known, but is it not possible that it may have some relation to the mysterious breakages of springs that frequently occur?

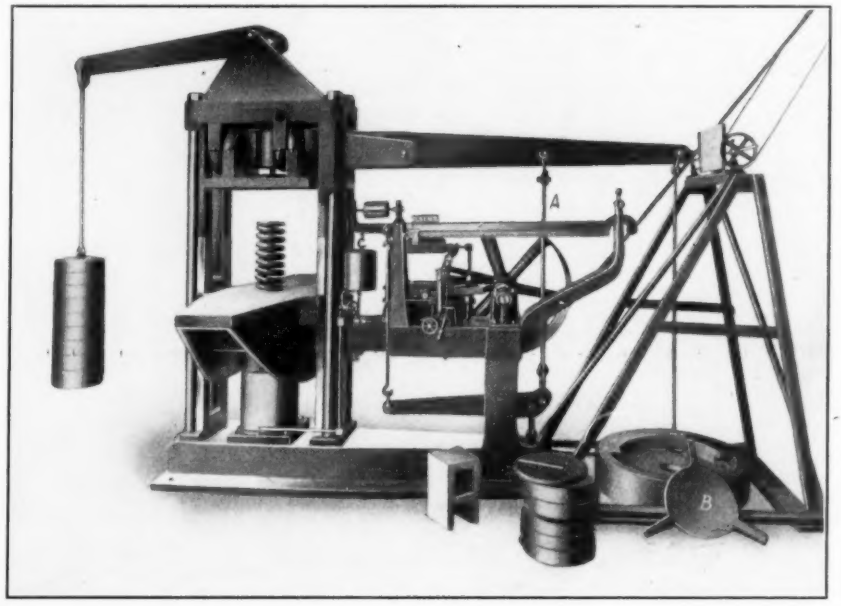


FIG. 1. TESTING MACHINE ARRANGED FOR TESTING SPRINGS.

Bill had a billboard. Bill also had a board bill. The board bill bored Bill so that Bill sold the billboard to pay his board bill. So after Bill sold his billboard to pay his board bill, the board bill no longer bored Bill.—*Yale Expositor.*

Not more than one-tenth of an ounce of radium is known to be in existence. The amount of radium salts, commonly spoken of as radium, is small also.

Symbolling a Machine for Interchangeable Manufacture.

BY F. W. MC ARDLE.

In systematizing work for interchangeable manufacture, one of the first and most important things to take up is the numbering and symbolling of the parts. In every machine most of the details, if given a name only, would be confused by different people, as no two would give more than a few of the parts the same names or even similar ones. This is particularly true where the machine is at all complicated. Parts which perform more than one function are sure to be confused, and identified by different people with the different functions. In this way, while two may refer to a certain part, it often needs an explanation to make sure. Moreover, granting that each part has its particular name, and is known by that name, these names become so cumbersome, if carried out in systematic connection with a fundamental part, that it would be impossible to carry more than the more important ones in mind. I have known of cases where a taper pin, ½ inch long and of a very retiring nature, has had a name on its detailed drawing 4 inches long. This is no exaggeration, as anyone who has attempted to name every piece on a machine in logical connection can testify, as such a detail will often refer back thru other connections, levers and shafts to a basic detail. At first sight this would appear unnecessary and perhaps ludicrous, but the critic who would attempt to give a descriptive name to that pin, so that it would be plain to see what it was, where it was located and what it was related to, would find that there was "method in the madness." Symbolling parts reduces this trouble to a minimum, tho for the repair man and those who may have to send

for parts from outside, some name or designation is almost necessary in order to locate a part in the catalog of details.

This is particularly true as regards the new man who has to become familiar with the different parts of the machine, but it is surprising how quickly one becomes familiar with symbol numbers, even where the system is complicated, and with little effort learns to know the various parts by numbers in preference to names. A lated parts, not necessarily into a section, but which act together to perform some action or function in the cycle of the machine, must also be thought of.

There are few machines that cannot be divided into some sort of sections, even if there is a slight stretching of the imagination. For instance, there is always a base or frame, a main shaft, etc., on which there are parts more or less directly or indirectly dependent, and sections may be have its symbol, and a logical system, more or less satisfactory, will be established. If desired, breaks may be left between sections for parts which may be added later, as changes are made from time to time. Right here it may be said that when a change is made it is usually best to give such changed detail a new symbol, for it is not advisable to give two pieces the same symbol, even if one has become obsolete. It often occurs, with a

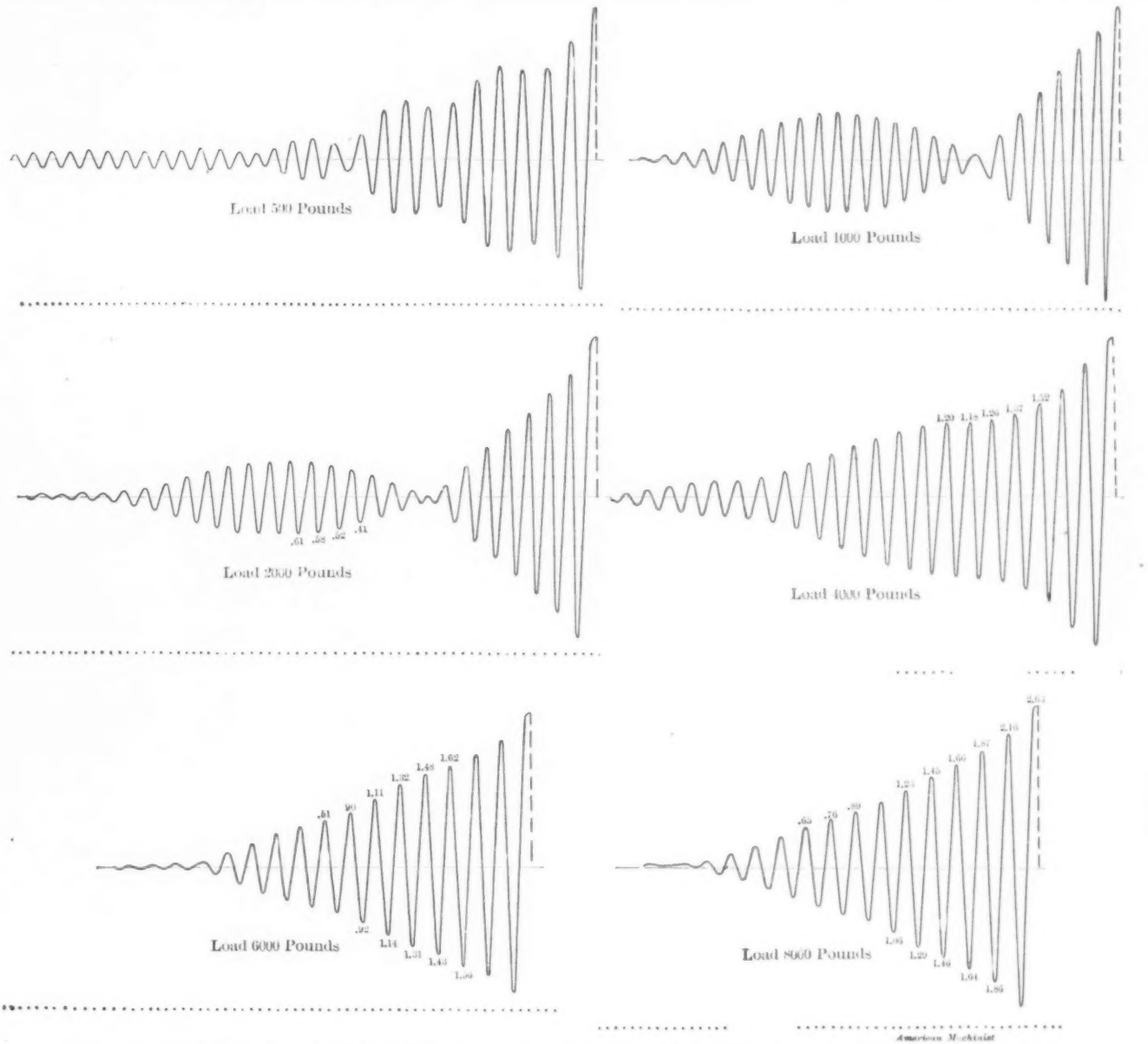


FIG. 2. RECORDS FROM A HELICAL SPRING OF 1.254-INCH WIRE, 5.264 INCHES COIL DIAMETER AND 8.75 COILS.

system of symbolling depends very much on the character of the machine itself, as a system that would work very well on one machine would not always be suitable for one of a different kind. It is often necessary to consider the modifications for different kinds of work to be done by the same machine, where a few changed details may adapt it to an entirely different purpose. The possibility of dividing the machine into complete sections which are capable of assembling before being put into place, or the grouping of core-made of these, even if they cannot be separately assembled.

SYMBOLLING ENTIRELY BY FUNCTION.

Perhaps the simplest form of symbolling is to start with the base or frame and calling that No. 1, symbol each dependent part in regular sequence. This will inevitably lead to some other important or fundamental part, which may be taken up with its connections when the first section is completed, and this in turn will lead to others, and eventually every part will machine passing thru the experimental stage, that a system is established before the machine is in shape for regular manufacture, and parts are symbolled that are discarded in future machines; but even here it is dangerous to use a symbol a second time if a record is kept of past experiments, for confusion is liable to occur unless the parts with the same symbol are used to perform the same function. Even here I believe it is preferable to leave the original part with the original symbol and give the changed part

some designation or a new symbol number that will show that there is something back of it, as many times it is desirable to refer to some of the original parts for record.

To follow this system, even with breaks or open numbers, it is difficult to even approximate the number of future additions that will be made in the course of time, and as a system once established is difficult to change, it is essential to divide the machine into convenient sections or groups if it is possible to do so. One method of doing this is to give each section or group a symbol letter; thus in a typewriter *A* may be the symbol letter for the frame and connected parts, *B* the keys and levers, *C* the carriage, and so on. While this system or a modification of it is used with good results in places where there are not a great number of parts, the new or changed details become separated from their logical positions, and the only way to locate them is by cross reference.

SYMBOLLING BY FUNCTION, MATERIAL AND CLASS OF WORK.

I have dwelt on this only to bring out the general principles involved, and while there are many better systems it would take too much space to even touch on some of them; but with this preface, I will describe in detail one system with which I have had considerable experience, and which is capable of expansion without complication. This is particularly applicable to constructions that have many details and that are subject to many changes and additions. This system is now in successful use in the manufacture of an adding machine, containing some 1,300 parts, of 500 or more different kinds. It is the result of experience with a number of good systems, the best points of which have been combined into one which meets the requirements. Changes and additions occur which make it necessary to change the symbols of parts and yet retain a knowledge of what has gone before. Changes which require new details require new symbol numbers, and these must all be provided for, not only for the immediate present but for the future, and in a way which will occasion as little confusion as possible.

With this system the machine is divided into sections, numbered from 1,000 to 9,000. Thus the 1,000 section is the superstructure, including base, frames, case and all details dependent directly on these parts. The 2,000 section is the keyboard and all connections, and so on thru the machine, each natural division being given a section number. Different classes of work are designated from 100 to 900 inclusive. Then 1 in the hundreds column indicates a shaft, 2 a punching 3 a screw machine piece, etc., 9 indicating a miscellaneous piece, such as a molded keytop or the felt on the keyboard. No. 2234 would therefore indicate at once that the part was a punching in the keyboard sec-

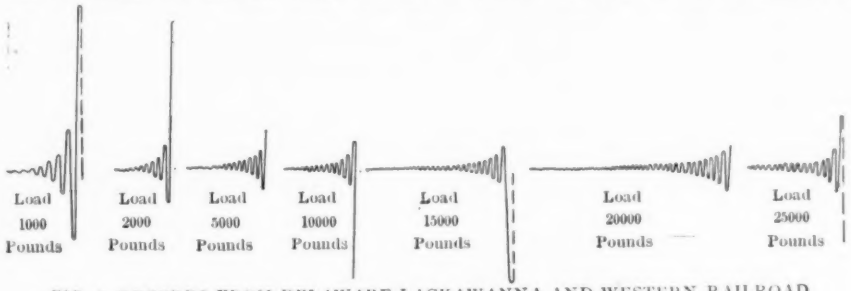


FIG. 6 RECORDS FROM DELAWARE LACKAWANNA AND WESTERN RAILROAD LOCOMOTIVE SPRINGS

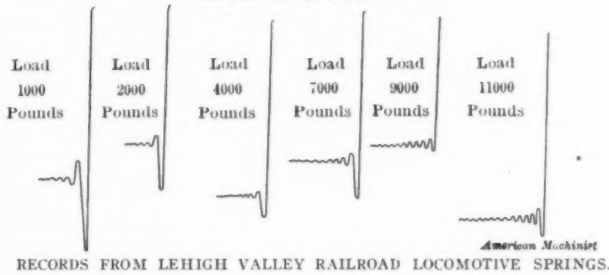


FIG. 7. RECORDS FROM LEHIGH VALLEY RAILROAD LOCOMOTIVE SPRINGS.

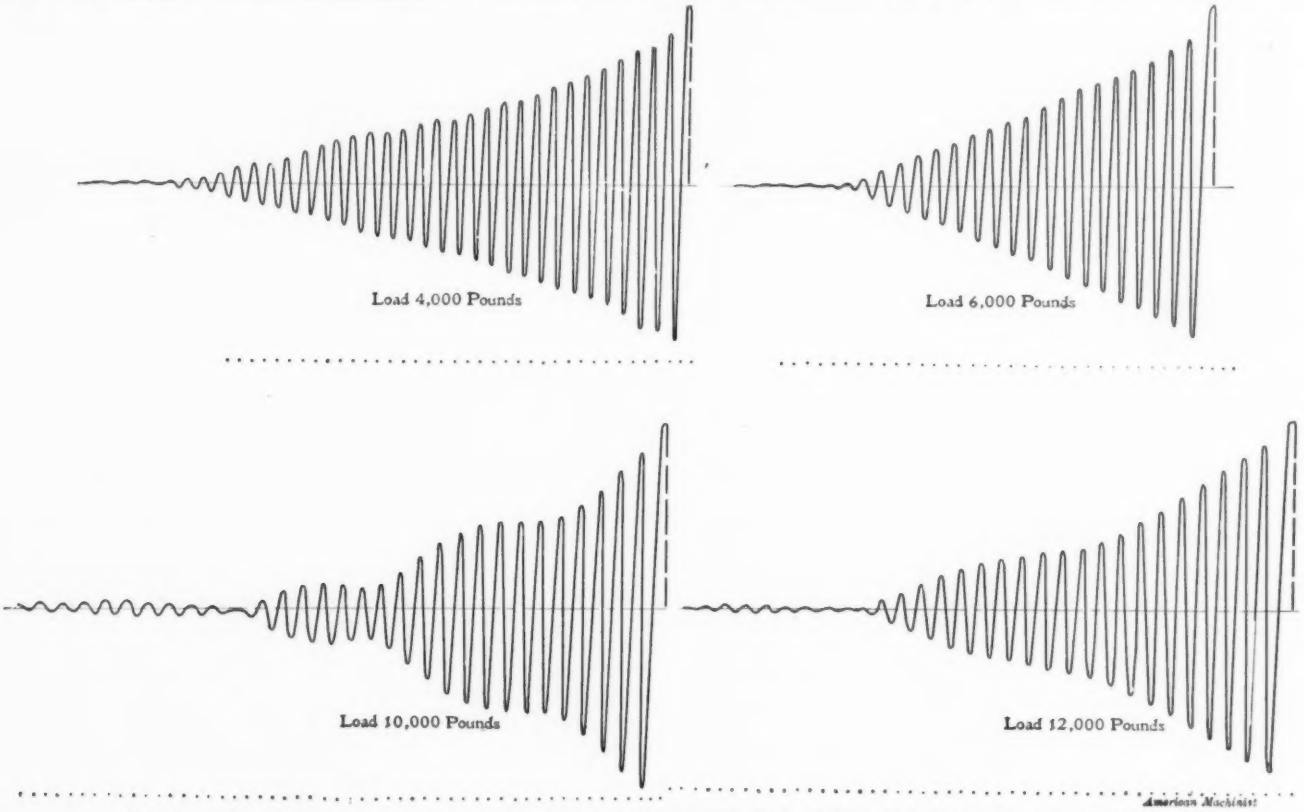


FIG. 3. RECORDS FROM A HELICAL SPRING OF 1.245-INCH WIRE, 5.03 INCHES COIL DIAMETER AND 4.7 COILS.

tion, 2,000. The different materials from which the pieces are made are indicated by the third or tens figure in the symbol number, and this must be arranged so that ample room is provided for pieces of each class and each material.

In this particular machine there are over fifty steel punchings in one section, and for this reason it was necessary to make the range for steel from 11 to 70 inclusive. 71 to 80 inclusive indicate brass, etc., according to circumstances. Thus 2234 or 2259 would each indicate a steel punching, and 2271 would indicate a brass punching. As there are materials used for one or two pieces that are used only for these, such as glass or felt, from 91 to 99 inclusive is left for miscellaneous materials.

The last figure or the last two figures in the symbol number indicate the number of the piece of each material in its class. As will be readily seen, this gives large scope for details of each class and each material in this class. Should a change be made in a detail which is slight, yet to be recorded, it is shown by affixing ½, a second change by ¼, and so on. For instance, 2234 indicates the original part, and 2234½ shows that some change has been made which is readily found by comparing the two drawings. When parts are added to a section, the next open number for the section, class and material, is taken.

Should more than one model of the same machine be made, the difference between two similar details may be shown, and also which models they are used in, by affixing the model letter, while parts that are used in all models are without a model letter. 2234A would show that the piece was used in the original model, while 2234B or C would show that the piece had been modified to be used in the later model.

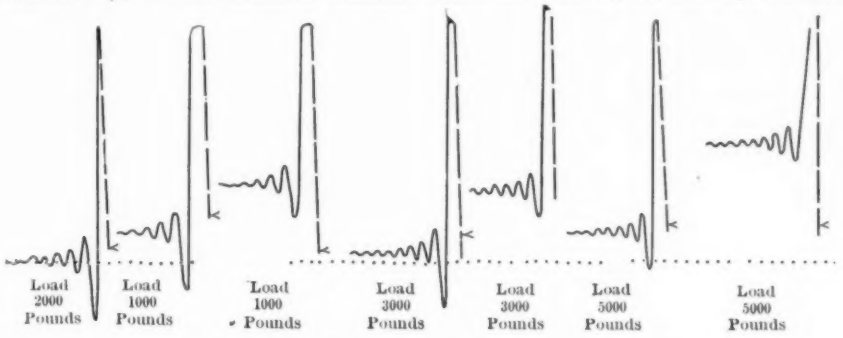


FIG. 4 RECORDS FROM A BRILL PLATE SPRING

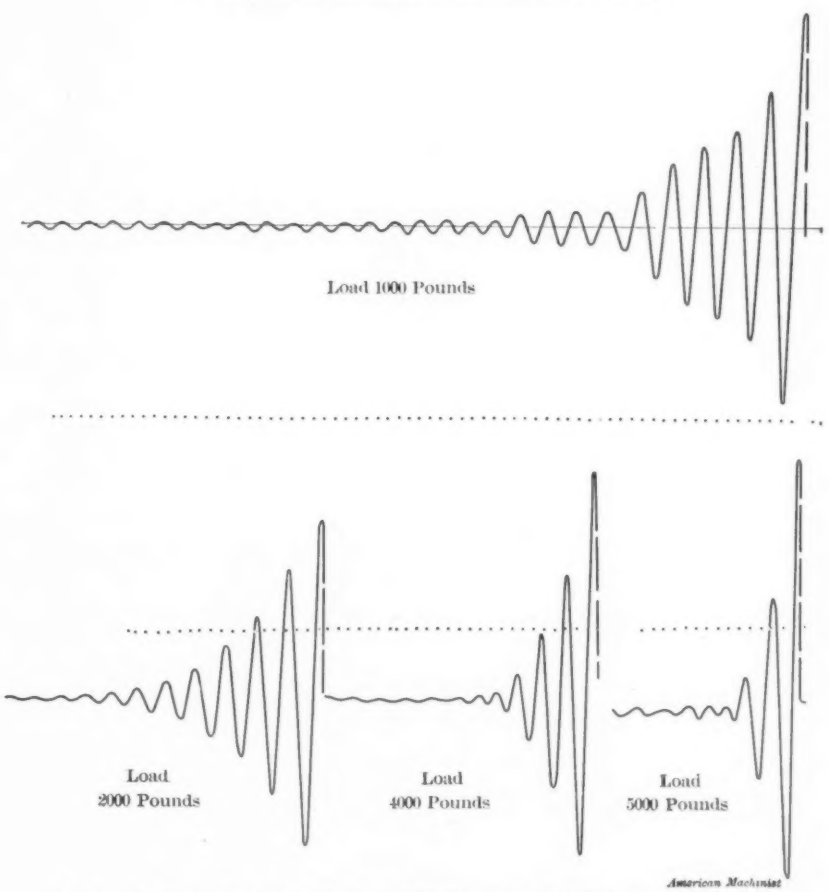


FIG. 5. RECORDS FROM A BRILL PLATE SPRING WITH ROLLERS BETWEEN PLATES.

NAMING PARTS.

Having established our system for part symbols, it is still necessary to give names to the pieces for the convenience of repair men or customers who may have occasion to order the parts from the factory. This is preferably done by taking a fundamental part as a basis and leading up to the part required by descriptive names. For instance, if a taper pin is required and it is known what piece it is used in, but neither the name of the piece nor the number is known, it is readily found by referring to some important piece which is logically connected, thus *driving lever, driving lever hub, hub taper pin,* etc. This can be readily followed out in catalog work by eliminating unimportant repetitions, as the fundamental piece can be readily found and the details followed down the page to the part required. In insignificant details, an explanatory note may be added to help matters.

For instance, 3318—*Operating lever spring pin (in frame* 1671). This is certainly an improvement over a system which refers to details on which the part is dependent, by number, as follows: 3318—*Pin in* 1671, which means that the uninitiated must hunt up No. 1671 in another section to find that 1671 is a frame on something else. In other words, the more cross references there are, the more the busy man desires to "say things."

Our system would not be complete unless provision was made to identify the assembled details, sub-groups and subsections. In this particular class of work there is much preliminary assembling. Punched pieces have hubs staked in, and of course lose their individual identity, and become one detail, which must have a symbol. This, with perhaps a similar piece and a shaft, are assembled and become a sub-group. Assembled sub-groups become sub-sections, and these combined become sections. When these sections are assembled we have the finished machine.

GROUP SYMBOLS.

These groups and sections are necessarily assembled in quantity, and some means are required to identify each different group, as they each become to all intents and purposes the same as a single part, and are handled as such, not only in the manufacture of the machine, but in sending for parts a section more or less complex is often required. Each group must be traceable to its proper section, and at the same time show that it is a combination; and it is hardly feasible to symbol it on the same basis as the single parts, as confusion would probably result, and hence a system of so-called dash numbers is used. These are composed in a measure arbitrarily, as the individual symbols are not traceable, except by means of the dash number catalog, in which the component details of every dash symbol are given, to

gether with the identifying name of the group.

The dash symbol is made up of two factors, separated by a dash or hyphen, the first figure indicating the section, and the second the number of the particular group in the section. These are numbered in the order in which they would naturally be assembled, and start from the simplest combinations, which are combined into more complex groups in the succeeding symbols. Thus, 2223 is a punching which, combined with a hub 2311, becomes the completed lever 2-1. This, combined with shaft 2111 by use of taper pin 2411, becomes a sub-group, with the symbol 2—2. This assembling into dash numbers is carried on until the final symbol of the section is practically the whole section, lacking only the few details which connect it with the rest of the machine, and which logically go with the section. This final group is given a distinctive symbol that may be readily remembered, such as 2—10, 2—20, etc., and when these various final sub-sections are complete it is only necessary to put all in place like single details and connect them to have the complete machine.

For this reason the final assembling of the machine may be done very rapidly, and, as a matter of fact, one man may set up as many as six or eight machines in a day, having these various sections ready. As has been mentioned, the superstructure is known broadly as the 1000 section, and the dash numbers start in the same way as in the other sections, and when the assembling has proceeded to the point where a dash number of another section is added it is merged into the 1000 section, taking the next dash number; for instance, 2—20 is added to 1—15 and the section becomes 1—16, 2—20 being the keyboard with all parts ready to connect to the actuating mechanism. 5—40, the paper carriage and guide is added to this and it becomes 1—17, and when all parts are connected and the covering case is put on the whole becomes model A, B, C, etc. This system has proven very satisfactory in this work, and may be used in many places, with or without modification. Both part and section symbols rapidly become fixed in the minds of all who are in connection with the work, both in the factory and the office, and it is rare that anything but the symbol is given when calling for a part or a group.

EXAMPLE OF THE SYSTEM.

The following will give a more complete understanding of this system if taken in connection with the foregoing explanation. These lists are taken directly from the catalog, and show not only the method used in giving names to the parts and sections, but the general manner of making up the catalog. In Table 1 the first figure gives the number of pieces used, separated by a dash from the part symbol, which is followed by the identifying name. Where a part has been used before, it is set out from the column of symbols, to indicate that fact. If the name becomes cumbersome by repetition, unnecessary foregoing parts are left out and the omission shown by setting the title one or more spaces to the right, with dashes to correspond with the number of times this has been done, as it sometimes occurs that this is necessary several times with intricate parts.

1—	5991	Platen.
1—	5992	— Center.
2—5227		— End Plate.
6—	5511	— End plate pin.
1—	5111	— Shaft.
2—	5993	— Corrugated roll.
2—	5311	— — Bushing.
2—5425		— Taper pin.
1—	5681	— Frame, right side.
1—	5682	— Frame, left side.
1—	5112	— Front rod.
1—	5113	— Rear rod.
4—	5412	— — Taper pin.
1—	5114	Feed shaft.
2—	5683	— Shaft arm.
2—	5711	— — Arm tension spring.

TABLE 1. 5000 SECTION. PAPER CARRIAGE AND CONNECTIONS.

Table 2 shows a part of the catalog of the assembly symbols, or dash numbers, for the same section as Table 1.

1—5992 2—5671 6—5511	5—1, platen center.
1—(5—1) 1—5991	5—2, platen.
1—5993 1—5311	5—3, end roll.
1—(5—3) 2—5512	5—4, roll with set-screws.
1—5684 1—5413 1—5711 1—5514	5—5, paper guide plate arm.
1—(5—2) 2—(5—4) 1—5111 1—(5—11)	5—20, platen and frame, complete.

TABLE 2. 5000 SECTION DASH NUMBERS.

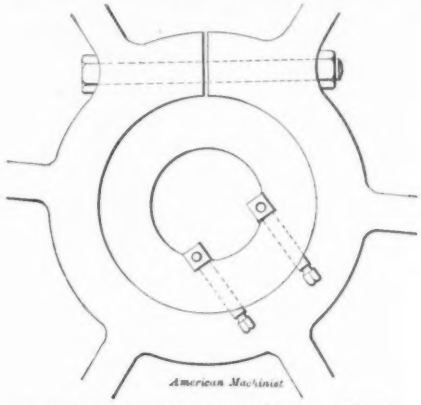
This sub-section with several others of like character are finally assembled, and eventually become 5—40, which is the 5000 section without one or two operative connections. A little study of this system will readily eliminate any apparent complications, and point the way to adapt it to other lines of work.

The summer session of the Armour Institute of Technology, Chicago, begins June 26 and ends August 4. Courses are offered in mechanical, electrical, telephone, civil and chemical engineering, drawing, shop work, manual training, mathematics and physics. Full information may be had from the Dean of Engineering Studies, Armour Institute of Technology, Chicago, Ill.

Letters to the Editor.

Keying Hubs on Shafts.

In reply to Mr. Wertheim's criticism, at page 258, of my squib concerning the keying of hubs on shafts, I wish to say that I guess Mr. Wertheim is right. I am afraid I overlooked the principle involved in the

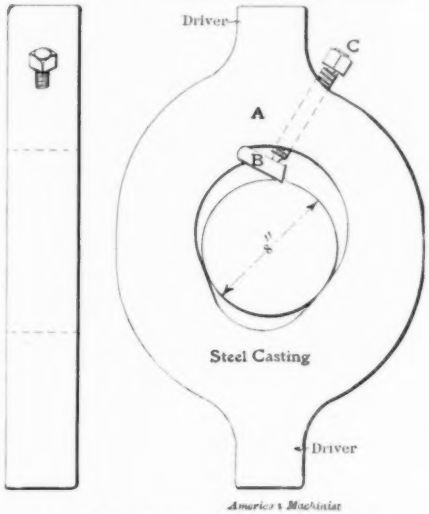


THE BALL & WOOD METHOD OF KEYING.

use of the two keys, and considered the question from the standpoint of one key placed cornerwise, which I had seen fail. Since then I have seen a two-key method, such as Mr. Wertheim describes, used upon a Ball & Wood high-speed engine, the only difference being that in the Ball & Wood construction the keys were further secured by means of set screws, and the hub of the wheel was split and clamped upon the shaft by means of a bolt. To facilitate withdrawal of the keys, a hole was tapped in the end of each one, as shown in the sketch. GEO. WILSON.

A Roughing Carrier for Large Shafts.

In my travels I very often see tools and appliances out of the ordinary. The shaft roughing carrier as shown in sketch



A LARGE SHAFT ROUGHING CARRIER.

I saw doing most excellent service in the Pittsburg district, and may be of some use to others.

A is a steel casting made extra heavy, and no machining whatever is done upon

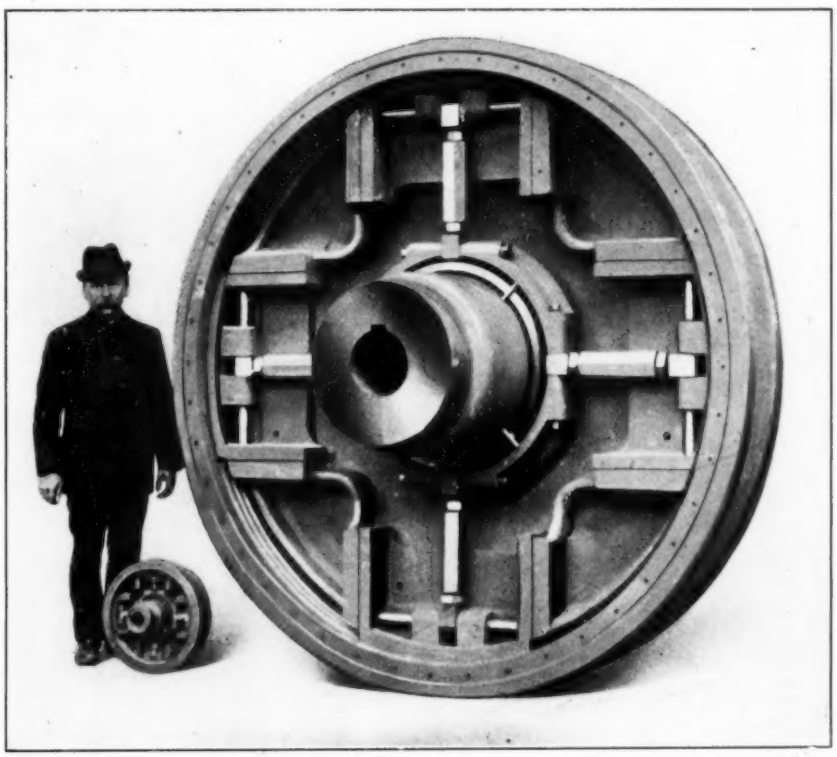
it except to drill and tap for the screw *C*. *B* is a forged tool-steel pawl, and is hardened to a chisel temper at its point of contact with the shaft. The set-screw *C* is forced against *B* near the point of contact, as shown, making a very simple and efficient carrier. BECK.

A Large Friction Clutch.

The half-tone shows a shaft coupling, made by Polysius of Dessau, that carries 1,000 horse-power at 150 turns per minute. It is 2,200 millimeters (86.62 inches) in external diameter, and weighs 6,130 kilograms (13,516 pounds). The driving shaft carries the rim and the driven shaft the hub with the locking and releasing attachments. Motion of the latter parts lengthwise of the shaft presses four gray-iron shoes, by means of four knee joints, against the overhanging rim, thus throwing in the driven shaft. There is a ring-shaped, flat section steel spring against which the four knee joints press, in throwing in the driver. This ring-shaped spring effects equable distribution of the pressure among the four friction shoes, and prevents displacement of the shaft axes.

As the bolts of the throwing-out sleeve have plenty of play in the oblong holes of the knee connections, the springs can easily come into action, and the sleeve is relieved of pressure from the knee connections.

The ring-shaped spring effects an easy action and allows the knees to pass the dead point, so that once the coupling is thrown into drive it remains so until purposely thrown out. The four knee connections are adjustable in length by right and left screws to allow for wear of the friction blocks. The coupling is thrown in and out of drive by one man by the aid of a screw and hand-wheel operating a forked lever. ROBERT GRIMSHAW.

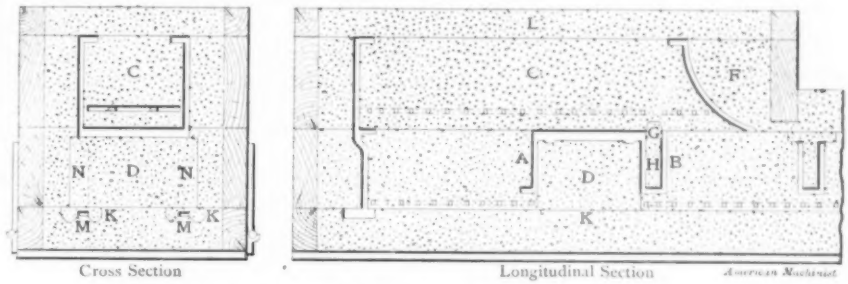


A LARGE FRICTION CLUTCH.

Molding a Gap Lathe Bed With a Regular Pattern.

Gap lathes are not a very common American product, but there are enough of them built for the following account to be of interest.

To begin with, it is both desirable and possible to use the regular standard lathe bed pattern without alteration except by the addition of loose pieces and core boxes. The bed is put in the sand, top down, and rammed up just as usual, and in the same flask as for the regular bed. The green sand core for the body of the bed is also made in the usual way, except that at the head end, where the gap opening is to be left, two special ties, *A* and *B* are cast in and the space between them is left open; or, rather, this space is rammed up like the rest until green sand core *C* has been rammed up over it, and then this space is dug out. After the bed is rammed up the cope is put on as usual, except that at the head end it is built up, as shown at *F*, high enough to cover the "hump," as we call it, over the gap opening. This hump is a loose piece set on the main pattern and is drawn down out of the cope after the latter is lifted. After the main green sand core is rammed up, green sand core *C* is rammed up on a spider, as shown, so that it can be lifted off and set to one side. A bar is used at *G* to form a seat for core *H*.



MOLDING A GAP LATHE BED WITH A REGULAR PATTERN.

After all these cores are made and the mold is slicked up, the setting of the dry sand cores proceeds as follows: Cores *K* are set in the ways. They are shorter than core *D* by a sufficient amount to allow for the planing off of the ends of the ways to fit the gap piece. Gates *M* also are left thru cores *K*, so as to connect both sides of the gap opening. This is very necessary when pouring beds from one end only, as otherwise there would be a cold shut on the pouring side where the metal began to run over the gap opening and fill up the other side. Core *D* is set on top of cores *K*, openings being formed for it by loose pieces *N* on the sides of the bed. Core *H* is set on chaplets and centered by setting green sand core *C* down on it. The other tie cores, etc., are set as usual, and then the cheek is rolled up and the cope is set on. A second cope is put on over all at *L*.

Up to about 12 feet in length these beds may be successfully poured from one end; above that it is better to pour from both ends. No trouble has ever been experienced from these beds crooking, and not over two per cent. have been lost out of about a hundred and fifty which have come under my notice. This covers a range of sizes from 12 inches by 6 feet up to 30 inches by 25 feet, all sizes being made by this method with minor changes of design. E. H. FISH.

Worcester Polytechnic Institute.

Simple Remedies for Some Oil Troubles.

Did you ever have trouble thru the thickening of the lard oil in your bolt cutter? Ever have it refuse to flow in cold weather, until heated? Just add enough common kerosene to your lard oil so that it will flow readily and your

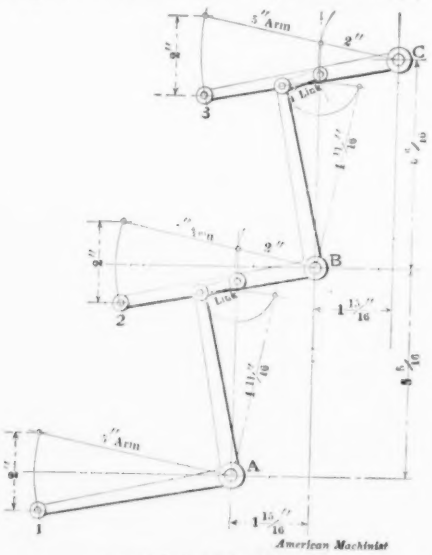
oil pump will work right along in the coldest weather.

Pumps on gasoline engines are not easy to keep packed without causing undue friction and wear. Of course no form of rubber packing will last, as gasoline cuts it out. If, however, you will try asbestos wick packing, rubbed full of common laundry soap, you will find that it packs tightly and works without undue friction; the soap also acts as a lubricant to the pump rod.

REPAIR SHOP.

A Curious Link Motion.

There seems to be no end to the queer mechanical movements that the design of automatic machinery will develop. The sketch herewith shows an odd combination of levers that came to light in our drafting room some time ago. Without attempting to describe the object or necessity of such a movement, I will simply



A CURIOUS LINK MOTION.

describe the movement itself, stating that it was necessary to have the point 1 move thru an arc of 2 inches, at the same time causing the point 2 to move thru an arc of 2 inches and back again in the same space of time that it took 1 to move one way. The point 3 during the same space of time was to make the 2-inch arc four times. That is, for every trip the point 1 makes, 3 would make four trips. The action is as follows: When the vertical arm of the double lever pivoted at *A* swings to the right and arrives at its middle or true vertical position, the point 2 is at its highest point, because the 1-inch link which joins the levers *A* and *B* stands vertical at this point. As *A* continues to the right, point 2 falls again to the position shown, having made the trip twice while 1 traveled only once. Similarly, point 3 travels two trips for every one of point 2, and consequently makes four trips for every one of point 1. It will be noted that there are only five pieces—three levers and two links—in the arrangement.

J. D. ADAMS.

Rig for Milling Keyways in Wheels Made in Halves.

The illustrations show a milling rig successfully used in milling keyways in pulleys and flywheels made in halves. Preferably the method of driving is a vertical drill with a swinging arm. The

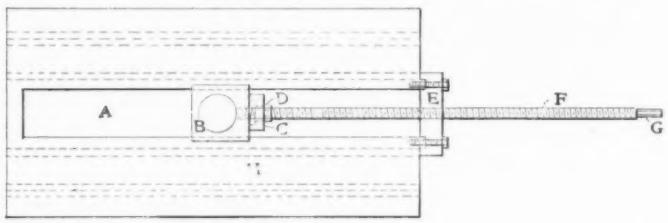


FIG. 1

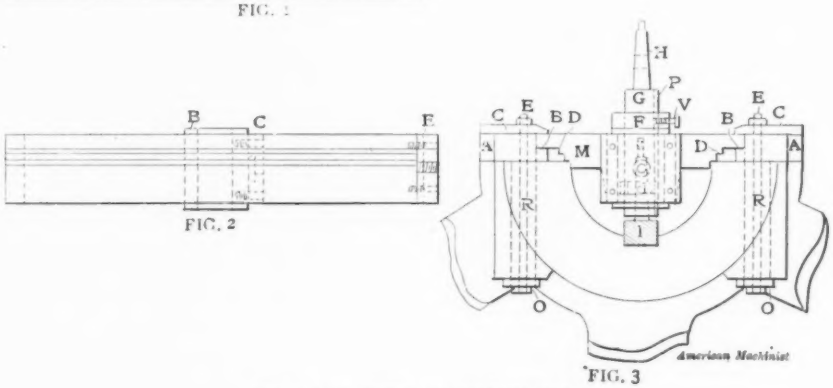


FIG. 2 FIG. 3

DETAILS OF KEYWAY MILLING RIG.

milling cutter driver *G*, Fig. 3, is an extension of the drill spindle, and is held in position by a cross-key. In operation the drill arm is left free to move to accommodate the straight line movement given to cutter by the guide *A* prepared in the body of milling frame, Fig. 1.

For parallel keyways the bottom of the bore and the top of the frame must be set level, as shown in Figs. 4 and 5, and for taper keyways the bottom of the bore must be first set to an angle, and then apply the frame, having the top surface set at right angles with the drill spindle. The milling frame is secured in the bore with clamps and bolts thru the hub bolt holes in the wheels, as shown in Fig. 3. The horizontal feed to milling cut is obtained by the feed screw *F*, which is operated with a ratchet fitted at end *G*, Fig. 1.

Fig. 1 shows plan of the frame *M*, having a planed guide *A* parallel with the radial projection that fits to bore of wheels. Box *B* is neatly fitted to guide portion *A*. Box *B* carries the milling cutter driver *P* shown in Fig. 3. Box *B* in Fig. 1 has a thrust bearing *C* counterbored to suit the enlarged end of the feed screw

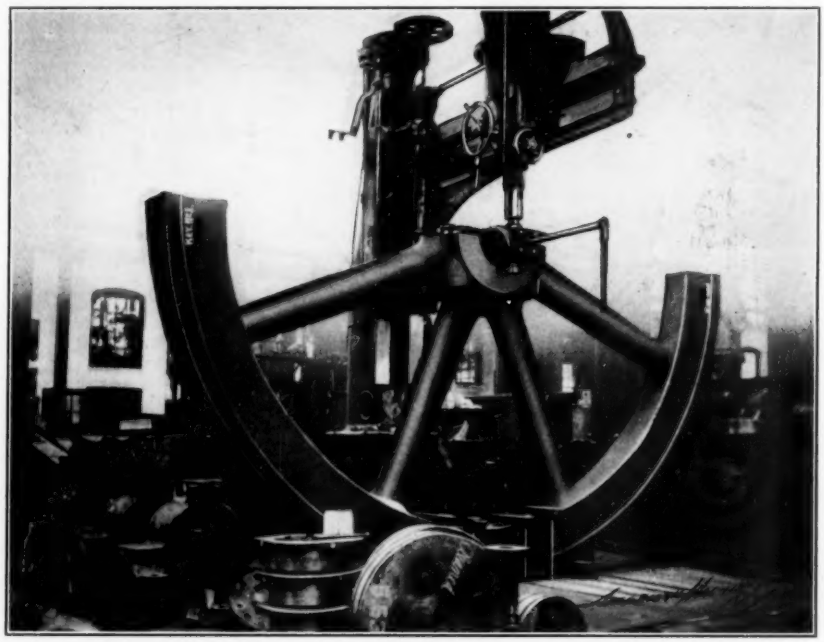


FIG. 4. MILLING RIG FOR KEYWAYS, SHOWING RADIAL DRILL PRESS.

F, and is secured to the box *B* by two cap-screws *D*. The feed-screw nut *E* has a tongue and groove fit to the frame, acting as brace to the open end of the frame.

Fig. 2, side elevation, shows box *B*, thrust bearing *C*, and feed-screw nut *E*. Fig. 3, end elevation of the milling rig, shows it attached to a flywheel hub by temporary bolts *E E* thru the hub bolt holes *R R* with washers *O O* on one side and clamps *C C* to the frame, and heel blocks *A A*. Blocks *B B* are supports to the overhanging portion of the frame *M*. The milling cutter driver *G* is provided with a depth collar *F* with a set-screw in the slot *P*. The slot *P* is to prevent burring of set-screw *V* to bearing surface of *G*. The milling cutter *I* is held in position in the driver *G* by the cross-key *K*. The driver *G* is secured to the drill spindle by a cross-key in the slot *H*. The projecting shoulders *D D* on the frame *M* are prepared for other sizes of bores.

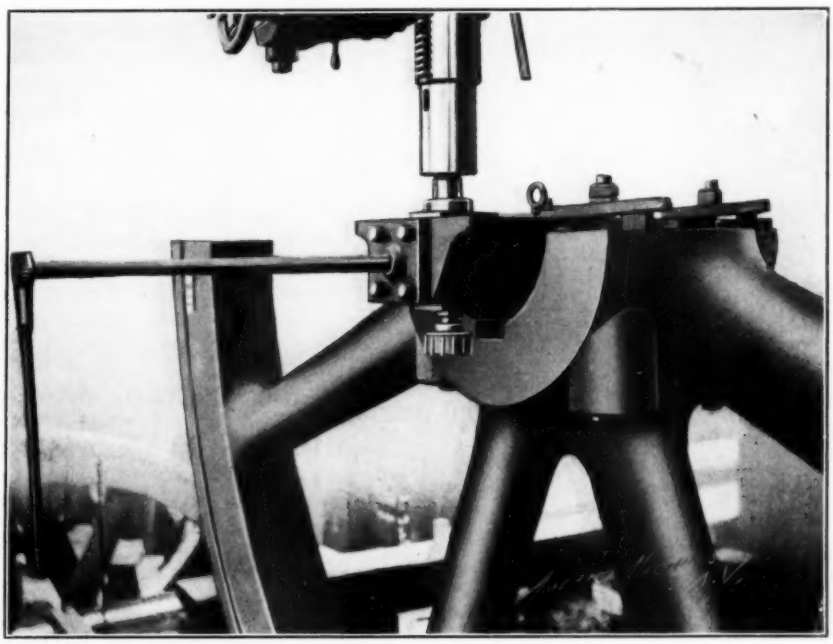


FIG. 5. RIG FOR MILLING KEYWAYS IN WHEELS MADE IN HALVES.

There are several advantages gained in using the milling device. It is easily applied and the operation of cutting the keyways while the half portions of wheels are in a vertical position does not require the room necessary for slotting machines, nor half the time in cutting the keyway.

GAFFER.

Making Drawings That Will Not be Misunderstood.

Referring to the article under this head at page 494, I beg to call attention to the fact that in Germany it is the general rule to use a sign for diameter after the figures, and if the sign is not used the figures are understood not to apply to circles. Why should a sign not be used in this country?

GUSTAV KROMPHARDT.

[We cannot conveniently reproduce the character which our correspondent states is used to indicate diameter on German drawings; it is, however, much like the "finish" mark commonly used on our drawings. In some drawing offices here the contraction *Dia.* or the letter *D* is placed after the figures which denote the diameter of a piece.—ED.]

Vertical Drawing Boards.

At page 389 "Cheddie" sings the praises of the vertical drawing board. I wish to say a few words on the other side. I have had about eight years' experience in the drawing office and have used both kinds of boards. For the last year I have been using an upright board, and I must say that personally I prefer the old-fashioned flat board.

"Cheddie" says: "As to utility, the upright board is vastly superior to the ordinary flat board, being able to take the largest drawing that is likely to be wanted." This depends on the size of the board. Most, if not all, boards of this type will only take a sheet of paper smaller than the board. This is because the square or straight-edge is generally fastened down at both ends of the board.

With the flat board it is quite easy to put on a sheet of paper considerably larger than the board. Besides which, two flat boards can, if necessary, be easily joined together and used as one board. One great fault of the upright board is the constant inaccuracy of the square or straight-edge. Owing to the effect of the weather on the long cord or wire by which this part is controlled, it is never true for long—at least not in this climate. I have had to adjust this part two or three times in one day.

Of course, in all properly constructed vertical boards this adjustment is easily made, but in practise I find that the draftsman often does a lot of work before noticing that the straight-edge is out of line. This, to say the least of it, is annoying to a man who takes a pride in his work. He has either to erase all the inaccurate lines or to work them in as best he can; and neither of these courses is very satisfactory. Another point against the vertical board is that it prevents one using the "universal" or any similar drafting machine. I think this is undoubtedly a disadvantage. I have not found the loss of this machine compensated by the various good points of the vertical board.

I could mention one or two other minor details in which I think vertical boards are not quite all that they should be, but I will pass them over and refer to what I consider the one serious drawback to the upright board.

I am, from my own experience, convinced that the long-continued use of this type of drawing board is very detrimental to the eyesight. The eye is admittedly one of the most sensitive of organs and is easily affected by surrounding conditions. It follows, therefore, that constant gazing at a white surface only a few inches from the face cannot but be injurious to the eyes in the long run. The advocates of the vertical board may say that this applies equally to all boards. In my opinion it does not. The man using the flat board is able to look up from his work, and constantly does do so for short periods. These periods provide a valuable rest for the eyes. The man using the vertical board has it continually in front of him while at work, and so does not get nearly so much opportunity to rest his eyes by looking over or beyond his work. When I began to use the upright board I soon found myself in difficulties. At the end of the day my eyes used positively to ache, and it was not until I had left the office for some hours that they regained their normal condition. After awhile this unpleasantness wore off, but now, at the end of a year, I find my eyesight distinctly impaired; so much is this the case that I am leaving my present position to go to another office where flat or horizontal boards are used.

It would be interesting, I think, to know if any other of your numerous correspondents have had similar trouble in this respect.

PHILIP BURCHETT.

England.

Cutting a Gear on a Horizontal Boring Mill.

We recently cut a gear—which was too large for our gear cutter—on a horizontal boring machine. The gear was supported on a gray-iron plate which was attached to the table and which had a turned boss on which the hole in the gear fitted. The gear was clamped in place by means of a bolt extending thru the bore and a clamp on the rim. The centers of the teeth were laid out on the pitch circle. It was set for

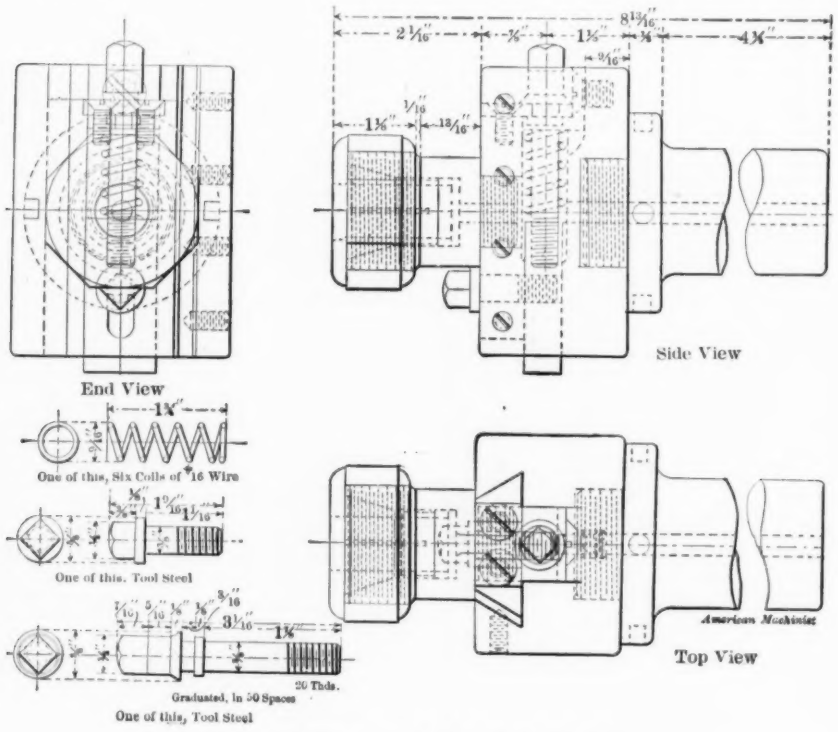
each cut by means of a tram. The table was raised and lowered by the belt feed, a large pulley being placed on the worm shaft to get the proper speed. The cutter was carried on the boring bar braced from the wall and the timbers overhead with wooden braces, which bear on the cutter bar as near the cutter as possible to prevent springing.

A built-up cutter was used. The blades were made of ¼-inch steel set in slots in the hub and held in place with No. 4 taper pins in slots between them. We find these cutters very handy. We have several different hubs, and whenever we require a new form we make a new set of cutters, which is quicker and cheaper than making a solid cutter. CARLOS E. HOLLEY.

A Recessing Tool Holder for the Automatic.

I am sending a drawing of a recessing tool-holder which may be of interest to my companions in oil who have any inside recessing to do. I will say that my object in this design was to secure a powerful oil supply for the cutting edge of the tool—something to wash out the chips. I had been using the ordinary style which swings on a stud, but had trouble. The hole would fill up with chips, preventing the tool from releasing, then when the turret returned the tool would break. Besides, I could never make two jobs alike, and the holder was gradually making me desperate. Well, one day when the inspector had just got thru explaining the inferiority of automatic machines as compared with hand machines, and for proof had exhibited a few recessed pieces, and I had felt too jaded for argument, I wiped the oil off my hands and face and took a walk out in the yard, and even risked discharge by sitting under a tree for half an hour. When I returned, somewhat calmer, I noticed the foreman and inspector in conversation. Presently, the foreman sent for me and I had visions of a pleasant future running a lathe or planer, for I was becoming disgusted with automatics. However, such was apparently not to be, for I saw him examining the recessing tool-holder, and from that knew he was going to give me an impartial hearing. I will not repeat our conversation, but this sketch is a result thereof. I came from his presence with head up and chest out, and in a very few hours had submitted to him this sketch. I believe a description is unnecessary. The side view shows the adjustment. At the bottom is a plate tapped out at the top, into which is fitted a screw with graduated collar. In adjusting you loosen the screw whose head is shown at the front of the plate, turn the graduated screw, then tighten. The coiled spring around the adjusting screw holds the tool central except when in operation. The shank is screwed into the slide block, which makes the tool-holder interchangeable for the several sizes of holes in automatic machines. I will say that I have found this tool-holder very satisfactory.

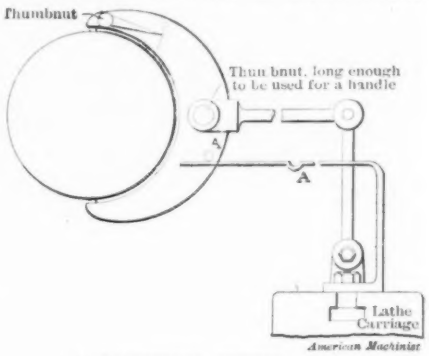
I see "Plodder" has been up against it in tapping pipe threads. From the drawings at page 603 I imagine the holder will be rather expensive, but it seems to be the correct thing for the job. I would suggest leaving the disk uncut and driving four pins thru instead of going to the expense of cutting the ratchet. YATESKI.



RECESSING TOOL HOLDER FOR THE AUTOMATIC.

A Calipering Convenience.

At page 1207, Vol. 27, is shown a large indicating caliper, which, like all tools of this kind, requires some place where it may be laid while the work is being turned to size. When not in use I carry it in the rear of the work, as shown in the illustration herewith. When not in use the caliper is moved back till the pin *A* drops into the depression in the supporting spring at *A*. Of course the whole rig can be removed by loosening the nut on the bolt in the carriage slot.



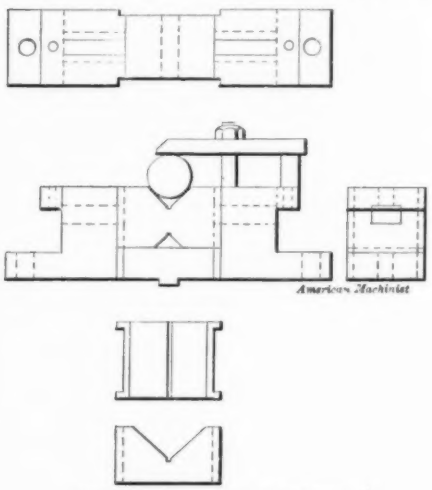
A CALIPERING CONVENIENCE.

AMOS PRICE.

Another V-Block.

I have been much interested in the various types of V-blocks lately illustrated in the AMERICAN MACHINIST and herewith present one of my own that I think has some good points not covered by those preceding it.

The illustration will show with little explanation how the main frame holds the blocks inserted from the top securely held in place by means of narrow flanges embracing the frame which is recessed on the sides to make block and frame come even.



INTERCHANGEABLE V-BLOCKS.

T-slots are cored in each side of the frame on top, eliminating the stud nuisance and permitting single or double clamps to be used. The top is extended a sufficient distance to accommodate the clamp block.

Blocks and jigs to fit odd shapes may

be used to advantage with this arrangement.

A bolt hole is bored thru the top extension at the outer ends for the purpose of inserting a short bolt, against the head of which the rear end of bevel clamp will press when using this style to plane thru.

J. J. NEWBAKER.

The Advantage of Special Tools in Forging—A New Zealand Time Card.

The sketches illustrate how with special tools work can be done in the forge by so-called unskilled labor, and also how skilled labor without special tools, even altho the work produced will only occupy the same time, cannot compete in cost with the combination of tools and unskilled labor.

Fig. 4 is a tie rod which is a part of the Westinghouse air-brake gear, as supplied to the New Zealand Railways. This part was formerly made in the old way. The ends or eyes were forged and then welded to a 7/8-inch rod to the required length. This involved two separate forgings and two welds, and the smith had hard work to make this job pay at 6½ pence, or 13 cents apiece. Later on another firm took up this class of work and it was then run thru in the following manner:

A set of cup dies to fit a bolt heading machine were made and fitted as shown in Fig. 1, as familiar to most of us. The block *a* is in two parts and these are 3 inches apart when the machine is at rest. The heated rod is inserted against the face of fixed block *b* and up against a stop, not shown, which determines the length required to form the head. The cam is engaged, the die block closes on the rod automatically, holding it tight, and the moving head comes forward and presses the rod into the dies, forming a complete ball. These dies are made of tool steel and hardened, the gripping surfaces being rough. When the furnace was properly going, the fuel used being oil, we could figure on 60 heads per hour, or 30 rods. The rods were heated for about six inches along the end, and the operator, who was a smith's helper, assisted by a boy, made them to a length gage, the greatest allowable error of which was 1-16 inch either way, the length of the rods used being carefully determined beforehand by experiment.

These headed rods were next handled by the 300-pound drop stamp, and Fig. 2 shows the dies for stamping the eye, and also how the lower half die is held on the hammer base. The corners of the gray-iron holder are cut away at an angle of 60 degrees, as this permits of a slight rotative adjustment, the sides also have a slope upward so that the holder is held against its seat by the adjusting screws. This is very convenient for the operator in adjusting his dies and helps to lessen the weight. The dies were made from tool steel and carefully hardened so as to avoid leaving a curved surface. A groove 1-16 inch deep and ¾ inch broad was milled all around the edges of the dies and ½ inch from it, as indicated at *d*. This was done to make sure the dies would come close together and also to provide a space for the "flash" or fin to flow into. These heads were brought to

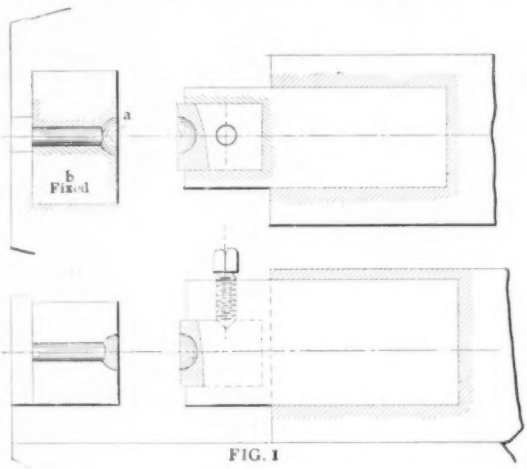


FIG. 1

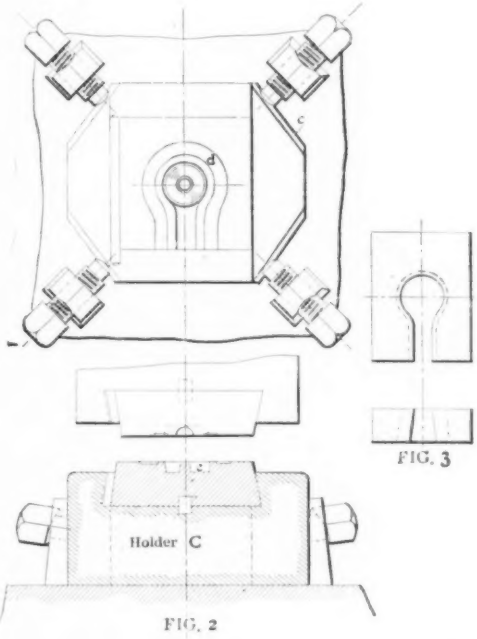


FIG. 2

FIG. 3

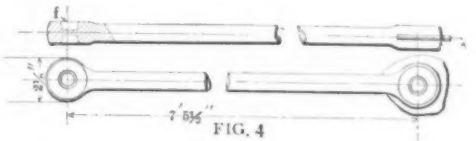


FIG. 4

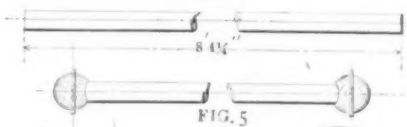


FIG. 5

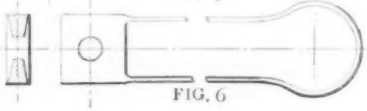


FIG. 6

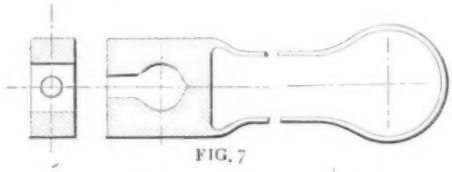


FIG. 7

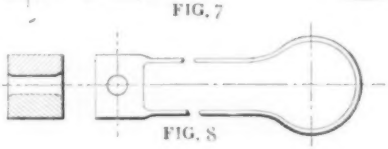


FIG. 8

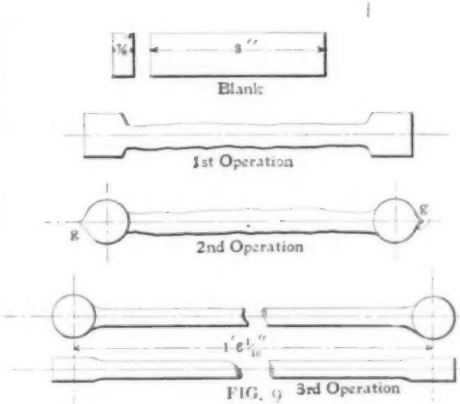
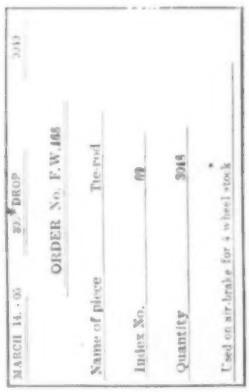
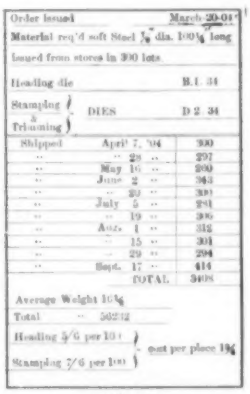


FIG. 9 3rd Operation




Order issued March 20-04
Material req'd soft Steel ⅞" dia. 100¼" long
Issued from stores in 300 lots.
Heading die B.I. 34
Stamping & Trimming DIES D 2. 34
Shipped April 7, '04 300
" " 28 " 297
" May 16 " 299
" June 2 " 303
" " 20 " 300
" July 5 " 291
" " 19 " 305
" Aug. 1 " 312
" " 15 " 301
" " 29 " 294
" Sept. 17 " 414
TOTAL 3408
Average Weight 10¾
Total " 36732
Heading 5/6 per 100 } cost per piece 19¢
Stamping 7/6 per 100 }
FIG. 10
American Machinist

SPECIAL FORGING TOOLS—A NEW ZEALAND TIME CARD.

a welding heat in an oil furnace and stamped to a length gage.

Fig. 3 shows the trimming die which sheared off the flash. This was made of tool steel and given a taper of 3 degrees. It could not be fitted to the ordinary trimming press owing to the length of the rod, so the trimming was done in the following manner. When the eye was stamped the operator's assistant placed the trimming die, which was comparatively light to handle, on top of the lower half of the stamping die and to one side. The eye was then placed in position by the operator and with a slight blow from the tup the flash was sheared. With the eye still inside the die he pushed the trimming die off the stamping block, then quickly turning the rod which he held in his hands, the trimming die dropped off on to a plate placed to receive it, so that the eye passed completely thru and came out at the bottom side of the die.

Great trouble was experienced in getting the centers of the tie rods correct. Even with a rigid gage attached to the base of a drop stamp which held one eye while the other was being stamped, the error would sometimes be as much as 1-16 inch, and as the holes in the eyes were drilled at the same time to exact distance they appeared to be out of center with the eye. To overcome this the stamping dies which were plain were discarded and a new set was made with a centering dowel, as shown at *e*, Fig. 2, which did away with the drilling jig altogether, as the drill followed the stamped hole, as indicated at *f*, Fig. 4, and the error, if any, appeared in the center to center distance and not in the eye. Owing to the saving of material by this method, the heading dies were reduced from 1¾ to 1⅝ inches, and the rods were cut 1¼ inches shorter, which on a large quantity meant a considerable saving.

FORGING WITHOUT SPECIAL TOOLS.

The tools shown in Figs. 6, 7 and 8 and also the numbered operations illustrate the very best method of making a similar tie rod of short length under a steam hammer by a skilled smith. The rod is made in one heat. The material is heated in the bar form and cut off; then by means of swages, Fig. 6, it is roughed out as shown in operation 1. Next one eye is formed and then the other by the repeated application of swages, Fig. 7, and the hammer itself. Then the finishing swages, Fig. 8, are used to bring the rod to correct length, the tails *g g* being cut off at the anvil. I have watched the piece being made in this manner many times and have seen a forging laid down complete before the color had left it. I have also watched this piece being made by the former method as described and the results were a reduction of 80 per cent. on the cost of production by the latter method. There were no special tools in the latter case, as the swages used are in every-day use for general work in the forge.

The skill of the smith has thus been replaced by means of tools which eliminate all inaccuracy, the necessary handling being done by the operators who are boys and smith's helpers.

A NEW ZEALAND TIME CARD.

The card system of running a job thru the smithy was used in the shop where these tools are, and altho most of us are familiar with it, its application to the forge may be new and hence interesting. On Fig. 10 is shown the front and back of the card which took care of the tie rod described. When the order for this item came along it was classified under "300 drop stamp" and given a filing index number. The order number, index number of piece, quantity and where used were stated on the front side just as shown. On the back of the card is marked all necessary information required as the job progresses. First is the material required as handled by the stores, then the tool numbers. The shipping receipts are carefully noted, as here is often a source of trouble. The total weight and average weight, the piece-work rates and the cost of production per piece fill the remainder of the card. Thus the whole history of this piece is brought together in a concise form and filed away for future reference; it also affords a key to the fixing of rates and prices on similar work.

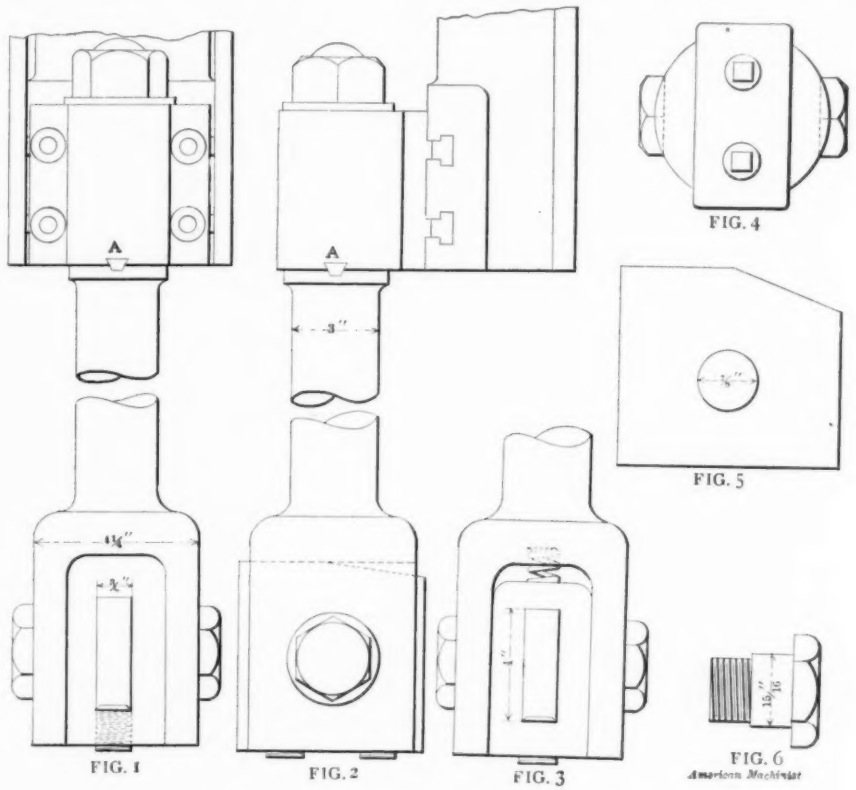
P. SANDIESON.

Improved Tool Bar for the Slotting Machine.

Of the various tool bars with spring release, described at different times by correspondents in the AMERICAN MACHINIST, I have never seen one to supersede the one here described for heavy service. It can be used on a variety of work, and is not likely to get out of order. The cutting tools keep sharp much longer than when used in a rigid bar, as the spring release allows the tool to return without much pressure on the cutting edge.

Fig. 1 shows the front view, and Fig. 2 the side elevation. *A* is a small key let into the gray-iron bracket, bored out to hold the reduced end of the tool bar. The top of the swell on the bar has four notches cut in it at right angles to fit the key. This prevents the bar from turning round under heavy cuts. Fig. 3 shows the back of the tool holder, and the plan of the bottom is shown in Fig. 4.

The bottom end of the bar is slotted out to receive the tool holder, Fig. 5, which should be a sliding fit on the sides and also on the top of the front half, the back half being cut away, as shown, to allow it to swing or tilt on the two cap screws, Fig. 6, which act as a pivot. The tool block is tapped out to receive the threaded ends, while the two sides of the tool bar are bored and reamed a sliding fit for the shoulder. A hole, ½ inch diameter, is drilled in the back of the tool bar, as shown in Fig. 3, to receive a spring which rests on the cut-away portion of the tool block, as shown. This



IMPROVED TOOL BAR FOR THE SLOTTING MACHINE.

keeps the front end tight up against its seat to take the pressure when cutting, and allows it to tilt when returning. The tool is held in by two set-screws on the bottom, ⅝-inch diameter, squared out for a key and case-hardened. For heavy work, we use a tool 3¾x11-16 inches, and frequently take a cut 1½ inches deep, with a traverse of 38 per inch on heavy forgings made of old armor plating. This puts a severe strain on it, but the two cap-screws, screwed into the tool block, prevent the forked ends of the bar from springing open and thus the bar stands some very heavy work.

"ARMOUR ENGLAND."

The Systematic Filing of Data.

It is not always convenient to keep all the back numbers of the AMERICAN MACHINIST and POWER in order to refer back to the various articles of interest, and if they are kept quite a search is necessary to find any particular article. In order to overcome these objections, and also be able to keep a great quantity of "live" data in a small space, I devised the following system, which is extremely cheap to install, requires a minimum of attention and is very simple to use.

First, I purchased 200 cheap 7x10½-inch envelopes, 100 8x15-inch plain cards, a 3x5-inch desk-tray card index with alphabetical guides, 300 3x5-inch cards, a wooden box 11x8x20 inches inside measurement, and I made another box, 8¼x5x15 inches long, and two follow-up wood pieces. I numbered the envelopes from 1 to 200 in the top left-hand corners. These I put in numerical order in the 11x8x20-inch box and adjusted the follow-up block so that it would be convenient to find any number. Then I treated the 8x15-inch cards the same way, except that they were numbered 1a to 100a.

I had a big collection of pages cut from the AMERICAN MACHINIST and POWER, some because of articles of special interest, others on account of the charts, curves, etc., which are extremely valuable. I made no attempt to sort them out, but picked the first, which happened to be a descriptive article on the Jones & Lamson lathe, and trimmed it down to the size of the reading matter, 7x10½ inches, including the date, and slipped it into the No. 1 envelope, and made out two cards, thus:

Jones & Lamson Lathe.
Description. No. 1.
Lathes, Turret.
Jones & Lamson No. 1.

The next sheet was a description of the Curtis turbine, which I treated in the same way, except that I put it in envelope No. 2, and so on with every sheet. Further along I came upon a curve showing the percentage of friction of a bearing at various speeds. This I cut out and mounted on No. 1a card, making out two index cards, one under the heading "Friction of Bearings" and the other "Bearings, Friction," numbering them 1a.

In this way I filed everything, and now as I come across items of interest I cut them out and file them in the same way. Sometimes it happens that two or three articles appear referring to the same machine, in which case I simply look up the number of the envelope containing the previous data and put the new matter in it without making out any new cards.

Every now and then I look thru the cards and envelopes and weed out all old and useless data. This filing system has unlimited capacity for expansion, and all references can be made instantly.

GEO. P. PEARCE.

"Making Drawings That Will Not be Misunderstood."

Referring to the article on the above subject at page 497, "C. A. T." writes us that he thinks the man in the shop would have found it much easier to have made the piece if he had had a different view—that is, the view shown herewith in Fig. 1.

"L. L. D." sends three views of the piece arranged as in Fig. 2, and says that

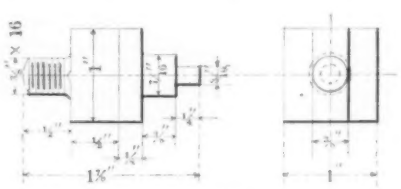


FIG. 1

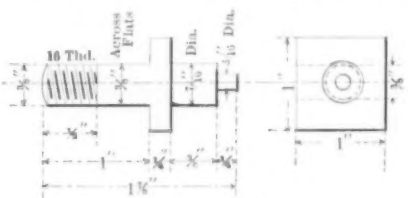


FIG. 3

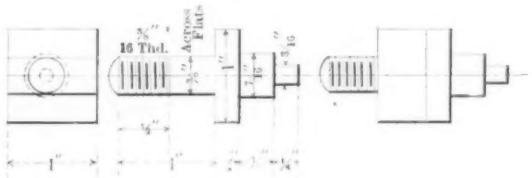


FIG. 2

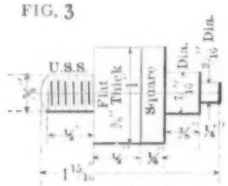


FIG. 4

MAKING DRAWINGS THAT WILL NOT BE MISUNDERSTOOD.

to show these views would take very little more of the draftsman's time and the piece would be clear to the workman. He further says: "It is a common practise with many draftsmen to detail the end view at the wrong end of the piece; in the piece in question the end view is of the threaded end, but Mr. Moss has detailed it at the other end in his sketch. This one failing has been the cause of more 'cuss' words than any other the draftsman is prone to.

"I am in a shop that receives about 1,000 drawings a month from the drawing room, and I handle nearly all of them, as I have to figure the premium limits on the detail parts, and I can most heartily sympathize with any kick on imperfect drawings. Our motto is, 'Be sure you are right before you go ahead'; if there is any doubt concerning the shape of a piece, or the proper reading of a drawing, take it up with the engineering department, and if necessary have the drawing changed."

Alonzo G. Collins sends the sketch Fig. 3 as his idea of the way the drawing should be made.

"Entropy" suggests three different ways of making the drawing. One of these is in accordance with Fig. 1, except that he uses the third angle of projection; another is the use of a top and front view in place of a front and end view; he states that for his own work where all he cares for is results he would draw the piece as in Fig. 4. "It is not scientific, but I do not see how a workman who can read English could fail to correctly interpret it. On the flat part I should be afraid that if I simply gave the thickness some workman might suspect that that part was square and in some way hollowed out to leave a thickness of ⅜ inch, but as it reads I feel quite sure of getting what I want."

We have received several other communications on this subject, but the various ideas suggested are pretty well covered by what is printed above and by the accompanying sketches.

So successful has been the manufacture of military rifles at the factory established in Quebec by Sir Charles Ross, that it is now proposed that Canada shall make her own cannon. The purpose in establishing the rifle factory in Quebec was to make the Dominion independent of English manufacturers, who, in the event of the interruption of communication, might be unable to supply rifles for the Canadian troops as rapidly as desired. The results have been entirely satisfactory. Now that the Canadian artillery is to be enlarged and rearmed with a more modern gun, it is held by military experts that the new ordnance should be made in the Dominion.

It is reported from Essen, Germany, that the Krupps' immense contracts, partly for the rearmament of the German artillery and partly Russian, Japanese, and Turkish orders, have required the company to increase the number of workmen from about 24,000 to more than 30,000. The insufficiency of dwellings for the workmen has compelled the management to erect temporary barracks.

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A Directory Swindle.

What appears to be a new game for obtaining some of the needful without working for it is being played in Cincinnati, and a letter from the Cincinnati Planer Company thus describes it:

"A solicitor appears on the ground with a United States Directory under his arm, immediately turns to the classified list showing such articles as are manufactured by the company, and asks if we desire to have these headings renewed; the price varies from $3 to $6. The thing looks all right, and we authorize him to fill out a blank, which in our particular case was for $5. He simply fills in the figures and passes the blank back, which you sign without much attention, probably by reason of the small amount involved. In the course of a few weeks another gentleman appears on the scene with a directory, he immediately opens it and shows you a display advertisement of one-half page, showing the cut of your machine, and presents his bill for $50. We knew very well that we had not made any such contract, and on looking over and scrutinizing it very carefully could readily see that an extra cipher had been inserted after the original $5.00, making the amount $50.00 instead of $5.00. On calling his attention to this matter he did not stop to argue his case, but said that there was probably some mistake, and that he would have the man who took the original contract come around and straighten it out with us. This gentleman, however, has never put in an appearance, notwithstanding the fact that it has been some months ago; and we don't think he ever will. They are doing business under the name of the Standard Press Company, New York, in some instances, and under the name of the Herrick Publishing Company, of New York, at other places. Upon inquiring around of the other manufacturers here in the city we find that these parties have called on most of them, and in some instances have no doubt had their bills paid. In talking with Mr. Le Blond, of the R. K. Le Blond Machine Tool Company, to-day, he states that their company was caught for $50.00 some time ago, and not very long afterward were presented with another contract and bill for $50.00, which caused suspicion, and on stating that they would refer the matter to their attorneys for investigation the party immediately disappeared and has never put in an appearance since.

"We think the plan that these parties pursue is to get hold of some United States directory, go around to the different houses as above indicated, and when they get a contract, go to some local printer, have an insert made with a page or half-page advertisement, rebind the directory, and present it to the party whom they desire to work. No doubt they have caught a good many people, and we think that a little notice of this practise thru your columns will save some of your readers and advertisers a few dollars."

Tho Mr. Quillan says in the above letter that "the thing looks all right," we do not think it really does. The only reason such things look all right to a busy manufacturer is because the amount being small, he pays little attention to the matter and signs without scrutiny a contract to pay $5.00. The essence of the thing is humbug, however, because this purports to be a directory, and yet the entries to be put into it depend upon whether or not manufacturers see fit to put up the price. What would be thought of a city directory purporting to give names and addresses of all the citizens of a place, but which really contained those names only whose owners had been foolish or thoughtless enough to pay a dollar for having them inserted? Such a directory would be a swindle upon the face of it, and every "directory" purporting to give complete lists of manufacturers or of manufactured goods, and which really contains the names of those only who have paid for such insertion, is fraudulent and those who go into it are dealing with men who will bear close watching.

Vertical Versus Flat Drawing Boards.

We publish elsewhere a letter relating to the subject of vertical drawing boards. Such boards are used much more abroad than they are in America, especially in the Continental countries. This is probably due, chiefly, to the fact that drawings on the Continent are usually made to a considerably larger scale than is the general practise here, and where large drawings are made, the evils of the flat board are of course much more manifest. The vertical board has certain objections. To begin with, ink does not flow so well from instruments held in the position necessary to use them on a vertical board. Again, the ink on heavy vertical lines has a tendency to flow downward and to make the lines at the bottom of the drawing denser than those at the top. This also delays drying of the lines somewhat, and thus impedes progress with the drawing. The draftsman's instruments cannot be kept in a place as convenient for him to reach them when wanted as is practicable with a level board, and he must reach a greater distance for them. Reference drawings, if they are used, cannot be kept in nearly so convenient a position with the vertical board as with the horizontal board, for usually these must be on a stand nearby, and in a horizontal position where reference to them is not at all convenient.

Again, while the various parallel arrangements have their advantages, it is doubtful if one has been produced up to date which will insure that the ruling edge will always move in parallel lines when the draftsman moves it by applying force near either end, and the cord or wire controlling its motion is likely to be af-

fected either by changes in the moisture of the atmosphere or by variations of temperature. While of course these last-named objections apply equally to parallel devices used on horizontal boards, they apply particularly to the vertical boards themselves, because no other kind of device is at all usable in connection with vertical boards; whereas with the horizontal board when one must do accurate work the T-square is always available.

Of course the experience of one man who has had trouble with his eyes, coincident with the change to a vertical board is not conclusive, but what our correspondent has to say about that feature of the case is at least worth noting.

Fulton, Fitch and Steam Navigation.

A discussion is going on in the columns of the New York *Times* at present relating to Fulton and his work, and the question of who is entitled to the credit of first propelling vessels by steam power. The general trend of the discussion seems to be in favor of the claims made on behalf of John Fitch, and it is stated most positively that Fitch was studying the problem of steam navigation and had actually reduced it to successful practise years before Fulton ever thought of it; that Fulton's work, or rather the work attributed to Fulton, is at best due mainly to Livingston, by whom he was employed, and that Fulton knew little of mechanical matters. In a letter by Henry M. Fitch—presumably a descendant of John Fitch—he uses the following quotation:

"An Extract from 'Reminiscences of Saratoga and Ballston,' by William L. Stone. Published in 1880 at New York by R. Worthington, 750 Broadway. Pages 235-8.

"At this point the Rev. Mr. Potter* (since the Right Rev. Bishop Potter of Pennsylvania), a young Episcopal divine, who is married to a daughter of the late Robert R. Livingston, and is consequently nephew by marriage of Gen. Lewis, joined in the conversation.

FULTON.

"'I am surprised, General, at your remarks,' said he, 'my own observation leading me to believe that many descend into history as successful claimants for public honors who, if the facts were known, would stand in a very different light. Probably no person has received so much praise and deserved so little as Robert Fulton. A man of no practical ingenuity, of no power of conceiving, much less of executing, an original mechanical idea, his friend Colton has succeeded in persuading the public that to him is due the successful navigation of our rivers by steam. The facts, however, as I gathered them from my father-in-law, and which I believe to be substantially correct, are as follows: For thirteen years before the first steamboat was placed upon the Collect [Pond] in New York, John Fitch had run a little steamer on the Delaware with great success. During that period he had experimented with various kinds of propelling power—the screw, sidewheel, and sweeps or long oars. The most primitive thing about this vessel was the boiler, which consisted simply of two potash kettles riveted together.

"'Mr. Livingston, who was greatly interested in the success of Fitch's experiments, seized the oportunity, when Minister to France, to visit the workshop of Watt & Bolton in England, where for the first time he saw a properly constructed boiler. But how was he to introduce it into the United States, unless (which was then impossible) he went there himself? At this crisis he thought of Robert Fulton, who, originally an artist in Philadelphia, was then exhibiting a panorama in Paris. His panorama, however, failing to pay, was attached, and he himself arrested for debt and thrown into prison. Livingston, falling into the error so common to many, of believing that because an artist can draw cleverly he must necessarily succeed equally well on mechanical conception and execution, paid off Fulton's debt and sent him over to New York with one of Watt's boilers. Fulton, however, failed to rise to the occasion; and when Livingston returned, a year after, he found his pet project precisely where he had left it several years before. He therefore at once took hold of it himself, and by his energy and perseverance finally brought his idea to a successful issue, Fulton, whom he could not entirely shake off, acting as a kind of general superintendent.'"

Those who are familiar with mechanical matters will be able to recall many instances in which men who have themselves done almost nothing toward the development of a mechanical or engineering invention have yet somehow succeeded in securing for themselves practically all the credit for it, to say nothing of the money. Such instances are occurring every day, and men are now living whose reputation as inventors is much greater than it would be were all the facts known as to who actually invented the devices brought out as their own. There is no doubt that Corliss enjoyed a much greater reputation as an inventor than he was really entitled to. There is no doubt that Sir Joseph Whitworth enjoyed a much greater reputation as an inventor than he was entitled to, and that others, and particularly Bodmer, the Swiss engineer, really invented many of the things for which Whitworth generally is credited. It is matter of record that Bessemer claimed and others claimed for him things that were invented by Mushet and others. It is easy to believe that Fulton in some way, perhaps thru no special fault of his own, has been credited with doing a good deal more toward the development of successful steam navigation than he actually did, and that John Fitch has received nothing like the credit to which he is entitled.

*These statements, moreover, are confirmed, not only by the late President William A. Duer in his "New Yorker" (Letter 7), but by Ransom Cook, now (1875) living at Saratoga Springs, N. Y. Mr. Cook informs me that in the summer of 1837 he was engaged upon his electro-magnetic machinery. Among his workmen were two who had been employed by Livingston and Fulton while those gentlemen were perfecting their steamboat. They surprised him greatly by stating that Fulton was a capital draftsman, and that was all. They added that he was so deficient in a knowledge of the laws of mechanics as to furnish daily mirth for the workmen; and that it was a long time before Livingston could convince him that the "starting bar" of an engine should be made larger at the fulcrum than at the handle!

A New Steel.

The Sheffield Steelmakers, Limited, of Sheffield, have recently introduced a new steel called "Unor universal air-hardening steel." Its wearing capacity is stated to be about half-way between the high-speed and the old type of self-hardening steel. One of the features claimed by the makers is that for hardening it is only necessary to heat it to a bright red, and then to cool naturally in the air, to be ready for use. Another point is that in re-annealing, after hardening, it is only necessary to heat the article to a cherry-red, then hold it over the flame till it becomes dark red, and plunge it into water. This will soften it to perfection. In tests made with twist drills of Unor steel at the Sheffield Testing Works, on a railroad tire made of Cammell's steel of 0.49 per cent. carbon, 49 holes, each 15-32 inch in diameter and 1⅞ inches deep, were drilled at an average speed of 25 seconds each. A 13-16 inch drill made from this steel drilled 20 holes 2 inches deep in 16½ minutes.—*Mechanical World*, London.

Washing the Air of an Office.

Very gratifying results are said to have followed the installation of an air washing apparatus in connection with the heating and ventilating system of the office building of the H. K. Porter Company, Pittsburg, Pa. The fan, heater and belted motor are installed in the basement in conjunction with the washer, which consists of a metal supporting frame filled with broken coke, over which water is allowed to trickle. The air as it passes between the fragments of coke is thoroughly cleansed of smoke and dust, which is washed down by the water to the bottom of the device and there removed. Previously to the installation of this plant, drawings, papers and the like became very dirty. It is now reported that they are kept perfectly clean at all times, owing to the fact that no air can go into the building except thru the heating apparatus, where it is very thoroughly and effectively cleansed. The slight pressure maintained within the building causes outward leakage at all points. The apparatus was designed and installed by the B. F. Sturtevant Company, of Boston, thru its local office at Pittsburg.

New Tools and Machine Shop Appliances.

MAGNETIC COUPLING AND ACCELERATOR.

The Cutter-Hammer Clutch Company, of Milwaukee, Wis., has recently placed on the market two interesting magnetic devices, of which we give illustrations herewith.

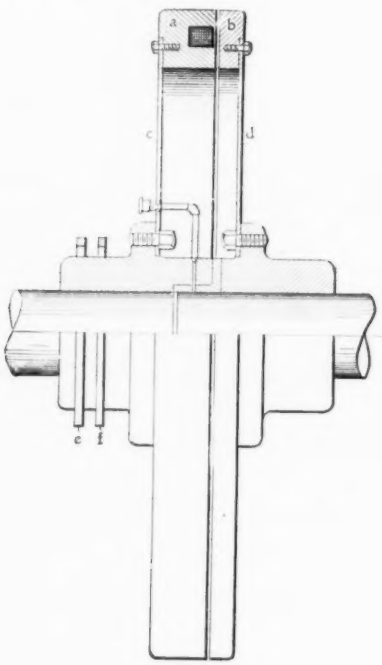


FIG. 1. MAGNETIC COUPLING.

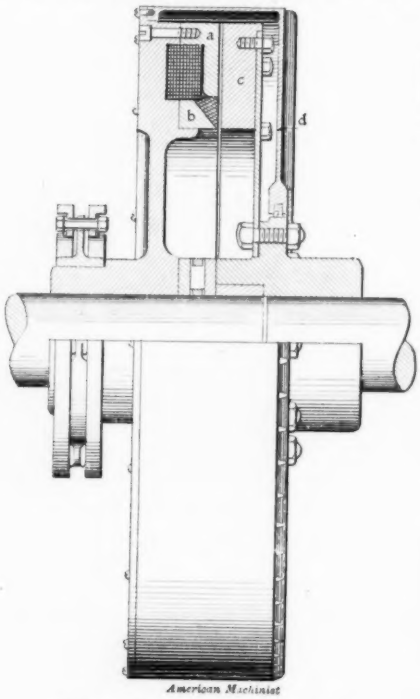


FIG. 2. MAGNETIC ACCELERATOR.

Fig. 1 shows the first, called a magnetic coupling, of which the office is to couple two shafts together, tho not to act as a clutch for putting one shaft in motion while the other is at speed. The intention is that the shaft shall be coupled when at rest or when running at the same speed and not otherwise.

Two cast steel rings *a* and *b* are mounted on flexible steel plates *c d* in such manner that normally the plates will maintain a small air gap between the rings. Ring *a*, called the field ring, has an annular slot containing an energizing coil, and when current is turned on thru the contact rings *e f*, ring *a* becomes a magnet and attracts ring *b*, called the armature to it, the slight movement necessary being permitted by the spring of the supporting plates, thereby locking the parts together with great force. Since the mere interruption of the current releases the coupling, its application as a safety device is obvious. It also has many useful applications in power-house work.

Fig. 2 shows the accelerator, which is intended to be used wherever friction clutches are applicable. The parts are drawn together in much the same manner as that already described, but the construction of the field rings *a b* is such as to generate powerful eddy currents in the armature *c* when the former is in motion and the latter is stationary or revolves more slowly than the former, the effect of these currents being to produce a torque in the armature additional to that provided by the friction of the parts.

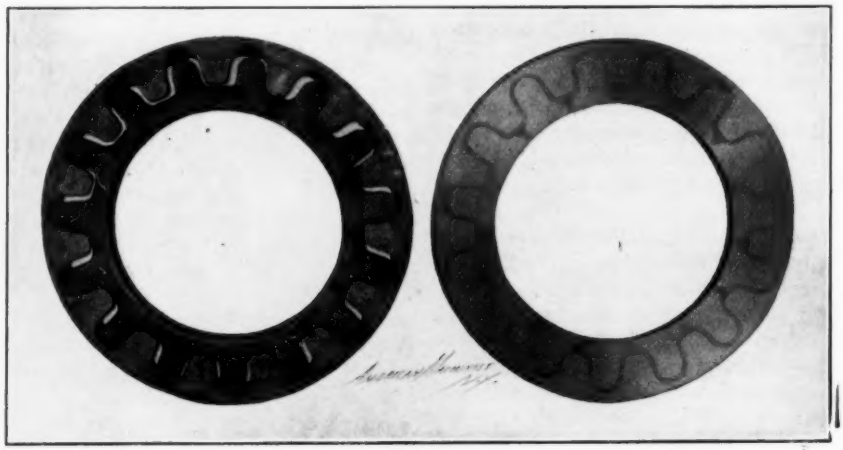


FIG. 3. FIELD IN THE ROUGH.

FIG. 4. FIELD BABBITTED.

The field is in two parts, having radially projecting and intermeshed poles, as shown in Fig. 3, which is from a photograph of a pair of rings in the rough. As finished, the spaces between the poles are filled with a non-magnetic material, such as babbitt, as shown in Fig. 4. The action of these poles is to get up an unequal distribution of magnetism in the armature and induce the eddy currents described. When assembled, the rings completely enclose and protect the coil, as shown in Fig. 2. The armature is mounted on a flexible disk, as in the case of the coupling, and the entire apparatus is enclosed by an oil-tight casing *d*, Fig. 2. Tapped holes for filling and draining are provided, and the friction surfaces are thus subjected to flooded lubrication. The exterior of the case is provided with ribs to assist in radiating the heat.

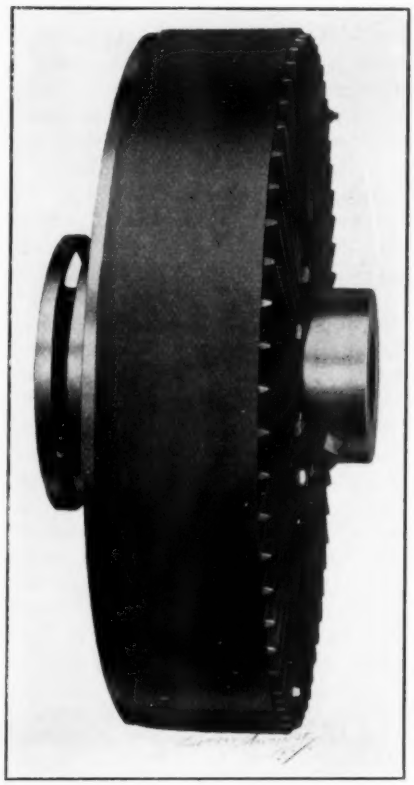


FIG. 5. ACCELERATOR COMPLETE.

In action, when the current is first established and a large difference of speed exists, the torque due to the eddy currents is very powerful. As the armature acquires speed, the torque diminishes and thus gives automatically the action due to easing the lever of a friction clutch. Meanwhile, as the oil is squeezed from the friction surfaces, the friction increases and the final grip is thus a powerful one.

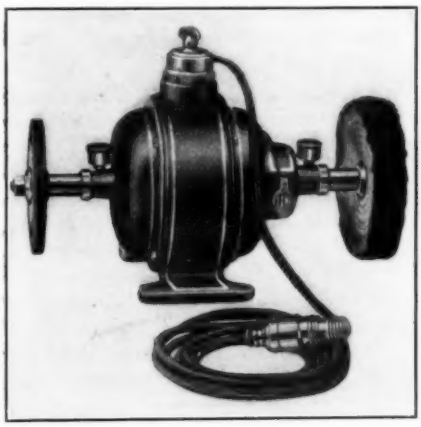
The action of the eddy currents is such as to give no shock in starting under any circumstances, tho for some purposes the start due to the abrupt application of the

entire current may be too quick, and in such cases a rheostat is used to regulate the application of the current, thus placing the time of the acceleration under the control of the operator.

The complete accelerator is shown in Fig. 5.

A GRINDING AND BUFFING MOTOR.

The illustration shows a portable ¼ horse-power motor, with an emery wheel



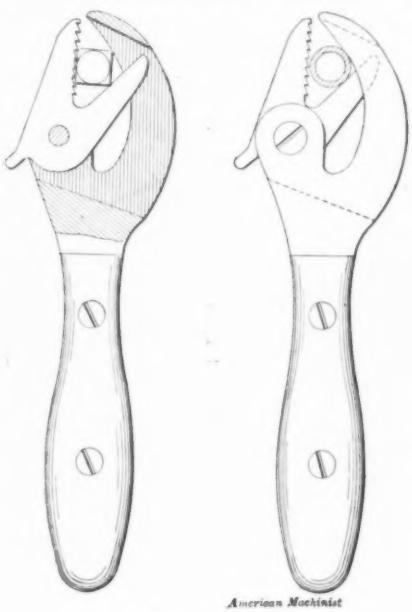
A GRINDING AND BUFFING MOTOR.

and a buff wheel mounted on opposite ends of the shaft. The working parts of the motor and the bearings, while easy of access, are thoroughly enclosed and protected from dust.

The machine is supplied with snap switch, 10 feet of flexible cord and an attachment plug. Larger sizes up to 2 horsepower are made by the same concern, the Lamb Electric Company, Grand Rapids, Mich.

A NEW WRENCH.

The cut shows one of the latest patented wrenches. With patents for wrenches issuing at the rate of two or three a week all the year round and year after year, it seems strange that one as simple as this could now be invented. We give it to our readers for what it may be worth. For a pipe wrench, the three points of contact seem much less likely to crush the pipe than the two points of bearing of the too-handy alligator wrench. Alfred Johnson, Chicago, is the inventor.



A NEW WRENCH.

A COLD SAW.

The illustration shows a 10-inch cold-saw cutting-off machine, adapted to cut rough or finished material of any shape up to its capacity.

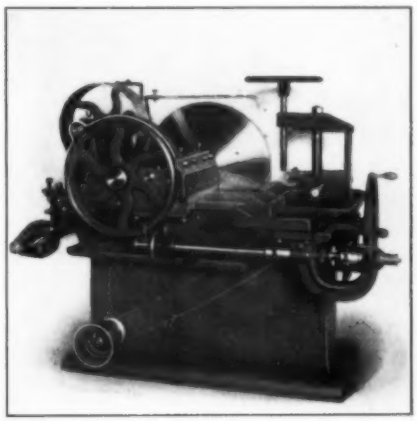
The stock to be cut is clamped in the V shoe by the screw shown in the illustration. The drive is positive thru a train of steel gears from the pulley. The feed of the saw is controlled by a lever from the front of the machine, and has a range of from 1-5 to ½ inch per minute. The return of the saw, after a cut has been made, is by power thru a clutch, which is thrown into engagement by the operator. The return can be made in forty seconds, and when the slide reaches the limit of its return travel, the clutch is automatically tripped. Means are provided for separating the oil from the chips, the strained oil returning to a reservoir in the base of the machine from whence it is taken by the pump.

A special saw-sharpening machine can be also supplied in connection with the machine. The machine weighs 3,000 pounds, and can be supplied with either belt or motor drive. It is built by Nutter Barnes & Company, 366 Atlantic avenue, Boston, Mass.

ELECTRICALLY DRIVEN SAND-MIXING MACHINE.

The accompanying illustrations show the well-known Sellers sand-mixing machine equipped with an electric motor by the Northern Electrical Manufacturing Company, of Madison, Wis.

The motor construction is modified to form a support for the mixer, as shown in Fig. 2. A special commutator bonnet forms a pedestal for the entire apparatus, the mixer being supported by a ring with radiating arms which is fitted to a raised and turned surface on the field-magnet ring. A suitable cover, shown in



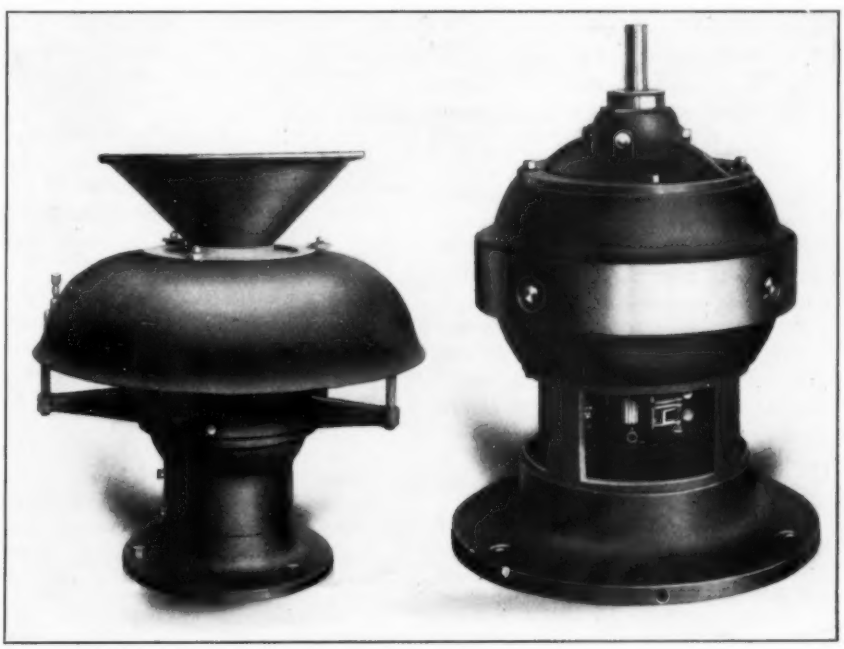
A COLD SAW.

place in Fig. 1 and removed in Fig. 2, protects the commutator from injury.

New Publications.

"The Pocket-Book of Refrigeration and Ice Making." By A. J. Wallis-Taylor. Fourth enlarged edition. 184 4½x7-inch pages, with 31 illustrations and numerous tables. The Norman W. Henley Publishing Company, New York. Price $1.50.

In very compact form this book gives a large amount of practical information regarding the installation and especially



ELECTRICALLY DRIVEN SAND MIXER.

the operation of ice-making and refrigerating plants. The first chapter gives an outline of the theory of refrigerating machines, together with an account of the essential differences between the different systems of refrigeration. This is the only chapter in the book that is in any respect theoretical, the remaining chapters being devoted to the arrangements and proportions of refrigerating plants and to the various factors of which a knowledge is essential to their successful operation Thus we find an extended table of the temperatures adapted to the cold storage of various articles as determined by experience, and another table of customary charges for the cold storage of various articles. The book is distinctly useful to those engaged in the installation and operation of refrigerating plants.

"The Art of Generating Gear Teeth." By Howard A. Coombs. 129 3¾x6-inch pages with 37 illustrations. Van Nostrand Science Series No. 129. D. Van Nostrand Company, New York. Price, 50 cents.

This is a reprint of the articles upon this subject by Mr. Coombs which appeared in our columns during 1903. It will be remembered that the articles went into the history of gear tooth generating processes quite extensively, and showed the line of development of such processes from their beginning to the present time. No such previous study had been made and the book is therefore of corresponding value to all who are interested in this class of work.

"Die Francis-Turbinen und die Entwickelung des modernen Turbinenbaues." By Wilh. Müller. Pp. 469, 7x10½ inches. Ills. 339, with 24 plates of turbine plants. Second, revised and enlarged edition. Hanover: Gebrüder Jaenecke. Price 24 marks.

In taking up a book on turbines in these days, one naturally assumes that it must relate to the steam-driven variety. This, however, is a treatise on machines driven by water power, as indicated by the name Francis, which designates the type most prominently considered. The work bears the appearance of very substantial character, a fact tended to be confirmed by the success of the 1901 edition, which has led to the issue of this revised one, wherein later results in the turbine line are added and various other changes made. The scheme of the treatise is threefold—First, a discussion of turbines in general and of different types; second, theory, construction, arrangement, regulation, efficiency, results of tests, etc., of the Francis turbine; third, the development of modern turbine building in Germany, Switzerland, Austria-Hungary, Italy, France, Scandinavia, England and North America. The descriptions of actual installations, with the many large dimension drawings in the plates ought to commend the book to practical men.

"The Cause of Business Stagnation." By Hugo Bilgram. 14 7x9½-inch pages. American Academy of Political and Social Science, Philadelphia. Price 25 cents. "A Commercial Clearing House." By Hugo Bilgram. 27 3½x6-inch pages. Published by the author, Philadelphia.

Mr. Bilgram is known to his friends to have devoted much study to economic subjects, including currency and banking. The two pamphlets under notice discuss the causes of the periodically recurring periods of business depression and suggest as a remedy his proposed plan of a commercial clearing house thru which debts shall be offset against and be made to balance and discharge one another without the intervention of money or its representatives in any form. The subject is discussed very clearly and simply, and the leading details of such a clearing house are carefully worked out. Mr. Bilgram is too logical and well informed a thinker for his suggestions to be ignored, and business men and manufacturers will find the pamphlets of a high degree of interest whether they agree with the author's conclusions or not.

"Gas Engine Design." By Charles E. Lucke. 254 6x9-inch pages, with 145 illustrations. D. Van Nostrand Company, New York. Price $3.

In this treatise familiarity with the inventive side of gas-engine design is presupposed, and descriptive matter relating to the construction of gas engines is omitted, the entire book relating to design in the sense of proportioning the engine and its parts. It is divided into three parts, of which the first relates to the determination of the size of the engine and to its expected economy. The second discusses the forces in the engine due to the pressure in the cylinder and to inertia, and the third takes up the dimensions of the parts. A free use of mathematics is made, and the book is adapted to those only who make considerable use of mathematical methods in designing.

"Loci in Mechanical Drawing." By Alexander MacLay. 120 5½x8½-inch pages with 74 illustrations. The Technical Publishing Company, Manchester, England. D. Van Nostrand Company, New York. Price 2s. 6d.

The author has already published a book upon this subject covering geometrical and mechanical loci. In the present volume he takes up loci representing the piston velocity and acceleration in the mechanism of the steam engine, the oscillating and other types being considered along with the ordinary construction. Those who are interested in the subject, which is of increasing importance in connection with the study now being given to the better balancing of the reciprocating parts of marine engines, will find in the book a very complete study of it. The discussion is partly graphical and partly mathematical, the two methods, as a rule, going hand in hand. While the text is liberally sprinkled with equations, they are not of a formidable nature, as in most cases they involve nothing more serious than plane trigonometry. In many cases the same problem is solved by means of various graphical methods, the authors of these methods being duly credited with their productions.

"Producer Gas." By A. Humboldt Sexton. 220 5½x8½-inch pages, with 80 illustrations. The Scientific Publishing Company, Manchester, England. Price 10 shillings.

The increasing attention now being paid to the use of producer gas in gas engines makes this an extremely timely book. It discusses the production rather than the use of producer gas, going with all necessary fullness into the properties of the gas and the details of producers and their use. The various types of producers are illustrated and described at length, a lengthy appendix being given to the most recent types of producers. A bibliography of the subject is also included in the appendix.

A neat and admirable bit of enterprise was the printing of the entire body of the *Railroad Gazette* recently in parallel columns of French and English in recognition of the assembling of the International Railway Congress at Washington.

Personal.

Albert S. Crane has become chief hydraulic engineer of the firm of J. G. White & Co., Inc., engineers and contractors, of New York.

Obituary.

Lorenzo S. Graves, founder of the Graves Elevator Works, Rochester, N. Y., died April 22, seventy-three years old. He first engaged in the shoe business in Massachusetts and later became a manufacturer of shoe machinery at Rochester. He built his first elevator in 1875, and in the line of hydraulic elevators developed one of the largest concerns in the country.

Our English exchanges tell us of the recent death of Captain Charles Ambrose McEvoy, seventy-seven years old. Captain McEvoy was born in Ireland, came to the United States when a boy with his parents and lived here forty years, serving the Confederacy during the civil war. He was associated with the bureau of ordnance at Richmond. He became a leading authority on torpedoes and mines and developed numerous important inventions in that line.

Business Items.

Rogers, Brown & Co. have removed their New York office to the new Trinity Building, 111 Broadway.

The American Electric & Controller Company (W. F. Burditt, Jr., president), has moved from 12 Dey street to 136 Liberty street, New York.

John F. Pitz, formerly superintendent of

the Judd Pattern Company, 87 Frankfort street, New York, has acquired the business interests and plant of that concern and will continue the business in his own name.

The Canadian Westinghouse Company, Ltd., recently sold to the Edmonton (Alberta) Street Railway Company a 200-kilowatt railway generator and a number of double equipments of railway motors. The city of Edmonton is the most northerly point on the American continent to operate an electric street railway.

At a recent meeting of the board of directors of the National Electric Company, Milwaukee, Wis., John F. Beggs was elected president of the company and J. H. Van Dyke, Jr., vice-president. Charles F. Pfister and Frederick Vogel, Jr., were elected directors. The National Electric Company is one of the important and promising manufacturing industries of Milwaukee, and under the new management will no doubt continue in its course of enterprise and prosperity.

Manufacturers.

The Pekor Iron Works, Columbus, Ga., is building new machine works.

The Guth Chocolate Company, Baltimore, Md., is erecting a new factory.

The Eagle Lock Company, Terryville, Conn, will erect a new factory.

The Lee Electric Light Company, Clarinda, Iowa, will put up a new building.

The Keith Company, Brockton, Mass., will enlarge its tannery at Campello.

The Cheney-Drewrey Iron Works, Carrollton, Ga., is erecting a new plant.

An electric power-house will be erected for the Reading (Pa.) Iron Company.

The Great Lakes Engineering Works, Detroit, Mich., will enlarge its plant.

Shippen Bros., Ellijay, Ga., will erect an electric lighting plant at that place.

The Lima (O.) Locomotive & Machine Company is making additions to its plant.

A. Booth & Co., Detroit, Mich., will erect a cold storage plant of large capacity.

The Power & Speed Controller Company, Watertown, Mass., will erect a factory.

The Commercial Club of Sheridan, Wyo., is negotiating for a beet sugar factory.

The Decatur (Ill.) Candy & Packing Company will remove its plant to Oshkosh, Wis.

The Detroit (Mich.) Steel Castings Company will erect a new plant, to cost $160,000.

Joseph H. Bromley, lace manufacturer, of Philadelphia, Pa., is erecting a $2,000,000 mill.

The Corlucci Stone Company, Scranton, Pa., whose plant was burned some time ago, will rebuild.

The Nagle Boiler & Engine Company, Erie, Pa., is erecting an addition to its plant, to cost $25,000.

The Milwaukee (Wis.) Light, Heat & Traction Company is enlarging its power-house at Waukesha.

The American Motor Company, of Cornwall, Ont., will establish a branch factory in Buffalo, N. Y.

The Clay City Roller Mills Company, of Clay City, Ky., has been incorporated with a capital of $12,000.

J. Thompson & Sons Manufacturing Company, Beloit, Wis., will erect a new gas engine machine shop.

The Maryland Steel Company expects to spend $2,000,000 in enlarging its plant at Sparrows Point, Md.

The Chicago, Milwaukee & St. Paul Railroad will build a new car erecting shop at West Milwaukee, Wis.

The Carrier-Low Company, manufacturer of folding boxes, will remove its plant from Chicago to Joliet, Ill.

The Utility Manufacturing Company, Fort Wayne, Ind., manufacturing razor strops, will enlarge its plant.

The Barber Manufacturing Company, of Anderson, Ind, manufacturer of bed springs, will enlarge its plant.

The German-American Button Company, of Rochester, N. Y., is considering plans for the erection of a large factory.

The Washington Manufacturing Company, Tacoma, Wash., planing mill and office fixtures, will enlarge its plant.

The American Brake Shoe & Foundry Company, of Mahwah, N. J., will extend its steel foundry plant at Chicago, Ill.

The Lamson & Sessions Company, Cleveland, O., making bolts, rivets, wrenches, will make an addition to its plant.

The Huber-Hodgman Company, Taunton, Mass., manufacturing printing presses, has plans ready for a new factory.

The Plainfield (N. J.) Cement Stone Company has been incorporated with a capital of $100,000, and will erect a plant.

The Chamber of Commerce of Santa Maria, Cal., are considering a proposition for a large glass factory at that place.

The McClintic-Marshall Construction Company, Pittsburg, Pa., will make an extensive addition to its plant at Rankin, Pa.

The sash and door factory of the Johnson-Smith Company, Minneapolis, Minn., was destroyed by fire; loss, about $16,000.

The machine shop and foundry of C. Rittenhouse & Sons, Norristown, Pa., was damaged by fire to an extent of $25,000.

Architect J. Mills Platt, Rochester, N. Y., is preparing plans for a new factory for the Piehler Shoe Company, at that place.

The Northern Pacific Railway Company is planning to make extensive improvements in its car shops at South Tacoma, Wash.

The Midgley Manufacturing Company, Columbus, Ohio, manufacturing steel tubular wheels, will erect a new factory shortly.

The plant of the Household Sewing Machine Company, at Providence, R. I., was damaged by fire to an extent of $100,000.

Hoy Bros., Elmira, N. Y., manufacturing boilers, stacks, etc., will erect a new plant, to be equipped with steam and electricity.

The Cadiz (Ohio) Electric Company is in the market for drill presses and other machinery for the manufacture of small brass work.

The Noiseless Car Wheel Company, of Chicago, is negotiating with the New Castle (O.) Chamber of Commerce for a manufacturing site there.

The National Manufacturing Company, Detroit, Mich., manufacturer of cooperage stock, will erect a branch factory in Niagara Falls, N. Y.

The Anniston (Ala.) Foundry & Machine Company is to have an addition for the manufacture of water and gas service boxes, soil pipe and fittings.

The Solar Carbon Works, Ravenna, O., were destroyed by fire; loss, $45,000. The plant was owned by the National Carbon Company, of Cleveland.

The Maryland Telephone Company, Baltimore, Md., has begun the erection of a plant, to cost $2,000,000, to furnish electricity for light and power purposes.

The Crawford Chair Company has been formed, and will erect a factory in Grand Ledge, Mich. B. A. Smith and Chas. Aldrich, of Grand Ledge, are incorporators.

The Falkenau Construction Company, Chicago, Ill., has been awarded the contract for erecting the new plant of the Troy (N. Y.) Laundry Machine Company at that place.

Frank Schaaf, a sausage manufacturer, of Milwaukee, Wis., will build a new factory, which will have two steam freight elevators, a 75 horse-power boiler and two engines.

The Pennsylvania Railroad Company has awarded a contract to George Scharf, of Buffalo, for the erection of one of the biggest blacksmith shops in the world at Olean, N. Y.

Jennings Bros., of Lopez, Pa., and Jennings, Md., are establishing a new town in West Virginia, which will be called Jenningston They will light the town with electricity.

The mayor and general council of Chattanooga, Tenn., are interested in a proposed big power plant for that city. They have assured the promoters every aid and encouragement.

A. E. Stevens, of Sioux City, Iowa, is forming a company, to be known as the Western Brass & Iron Foundry, which will manufacture brass castings, architectural iron, etc.

Plans are being prepared by Z. T. Davis, Unity Building, Chicago, Ill., for a $200,000 slaughter and packing plant for the Western Packing & Provision Company, a new half-million-dollar concern.

The Des Moines Manufacturing & Supply Company, East Des Moines, Ia., will enlarge its plant and take up the manufacture of iron and steel ware. The furnace department will be especially developed.

Clarence E. Regennas, Lititz, Pa., is fitting up a shop to meet the requirements of the general machine trade, and would like catalogs of power-transmission machinery, mill supplies, automobiles, engines and pumps.

The stockholders of the Lockhart (S. C.) Mills have authorized the issuance of bonds for the amount of $645,000 for the purpose of erecting another mill. Lockwood, Greene & Co., Boston, Mass., are the architects and engineers.

George Van Dyke, president of the Connecticut Valley Lumber Company, Holyoke, Mass., and brothers have formed a corporation with a capital of $2,000,000, and are preparing to erect mills for the manufacture of paper and wood pulp at McIndoe Falls, Vt.

The Bausch, Lomb, Saegmuller Company, manufacturing engineering, astronomical, physical and other instruments of precision, has been incorporated, and the plant of Mr. Saegmuller, at Washington, D. C., will be moved to Rochester, N. Y., in the recently completed addition to the factory of Bausch & Lomb Optical Company.

W. J. Jones contemplates installing an electric lighting plant of 35 to 50 kilowatts capacity at Wise, Va., and is in the market for a 35- to 50-kilowatt generator, a 50 to 75 horse-power engine, a 100 horse-power boiler and all supplies necessary for a small plant. Communications should be sent to Mr. Jones, care of Box 33, Wise, Va.

New Catalogs.

The Buffalo Forge Company, Buffalo, N. Y., has gotten out a pretty mailing card calling attention to its disk wheels.

Frank L. Patterson & Co., 26 Cortlandt street, New York. Circular and price list of the Patterson belt pump. Illustrated.

Electro-Dynamic Company, Bayonne, N. J. Circular of Inter-Pole variable-speed motor, replacing circulars 1, 2 and 3. Illustrated. 6x9, pp. 8, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Booklet entitled "Summer Comforts." This is a pretty little book describing and il-

lustrating "Wood" fan motors. 4x9, pp. 16, paper.

The Cushman Chuck Company, Hartford, Conn. 1905 catalog describing different chucks made by this company. It is illustrated and contains tables and price lists. 6x9, pp. 46, paper.

The Henry & Wright Manufacturing Company, 115 Sheldon street, Hartford, Conn. Catalog of ball-bearing drill presses (Rice patent), filing machines and tools. Illustrated. 6x9, pp. 17, paper.

The Seneca Falls Mfg. Co., Seneca Falls, N. Y. Catalog No. 20B, describing "Star" screw-cutting engine lathes, speed lathes, wood-turning lathes, attachments and accessories. Illustrated. 6x9, pp. 32, paper.

Cooper Hewitt Electric Company, 220 West Twenty-ninth street, New York. Bulletin No. 7, February, 1905. This describes the Cooper Hewitt mercury vapor electric lamp for direct-current lighting circuits. Illustrated. 6x9, pp. 28, paper.

The Robbins & Myers Company, Springfield, O. "The Standard Autograph and Picture Book—Products Edition." This is a very handsome book, printed on fine coated paper and containing excellent half-tone engravings. 8x10, pp. 57, paper.

Julian D'Este Company, 24 Canal street, Boston, Mass. 1905 catalog of the Curtis engineering specialties, including improved pressure regulator for steam, expansion trap, tank governor and pump combined, etc. Illustrated. 3½x6, pp. 32, paper.

The Geo. R. Rich Manufacturing Company, 171 South Canal street, Chicago, Ill. Booklet entitled "The 'Rich' Time and Money Savers," and which tells of the drill chuck, expanding mandrel and boring bar made by this company. Illustrated. 3½x6½, pp. 16, paper.

National Electric Company, Milwaukee, Wis. Publication No. 66 entitled "Plants and Types," showing a few illustrations and views of electrical apparatus installed by this company. This is printed on heavy coated paper and the illustrations are fine half-tone engravings. 6x9, pp. 31, paper.

The Westinghouse Companies' Publishing Department, Pittsburg, Pa., has sent us advance copies of two fan motor folders on the A. C. and D. C. types, which the Westinghouse Electric & Manufacturing Company is preparing for distribution. These are illustrated and contain full information about these motors.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & Dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Turret lathe work, light machinery, tools, models, etc. Metal Novelty Co., Elgin, Ill.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Machinist Table—Standard steam, gas and water pipe tapping sizes; 5c., stamps. E. E. Meyer, Allegheny, Pa.

Would like to build some standard specialty on orders; low prices; prompt delivery. W. S. Machine Company, care AMER. MACH.

Dies, jigs and fixtures; tools designed for special work; manufacturer of clockwork specialties and intricate mechanical instruments. D. S. Plumb, 57 E. Park st., Newark, N. J.

W. H. Chappell, the best shop organizer and manager in America and inventor of the red light system, solicits correspondence regarding engagements. Box 57, AM. MACH.

Wanted—Canadian right to build machine of established reputation; plant and equipment the very best for 500 men. Address "Business," Box 99, AMERICAN MACHINIST.

Would be glad to hear from anyone who has a machine of any sort they wish developed and manufactured; machine must be small, as the factory is only a small one; prices reasonable, and satisfaction guaranteed. Box 103, AMERICAN MACHINIST.

Engineer, after much experimenting, has perfected machine, of a class for which there is wide demand. Has operated machine for months under practical working conditions, discovering and remedying defects, resulting in complete redesigning, many improvements, new patents. Wants to arrange for manufacture under favorable auspices. Invites correspondence from machine shops and foundries; the latter would require only a few tools to handle. Advertiser, well known in his special line of engineering, has long experience negotiating sales, and knows the business thoroughly. Will continue to manage the selling. This is a good opportunity for parties looking for steady-going specialty. Machines weigh about 1,200 pounds, used in boiler-rooms; market from Maine to Utah. Would also consider connecting with large, well-known concern of highest reputation, that would finance the business clear through, on broad, country-wide lines; agencies, etc. Address Box 121, AMERICAN MACHINIST.

For Sale.

For Sale—U. S. patent rights for small machine of established reputation; demand great enough to keep large factory now running night and day. For particulars apply to Box 98, AMERICAN MACHINIST.

For Sale—Patent issued 1900, automatic lock for dumbwaiters, hoists, elevators, etc.; have sold over 3,000; able man could clear $5,000 to $15,000 yearly; manufacturers and mechanics with capital should investigate; low price. Address "Patent," AMER. MACH.

Business Opportunities.

We want a few thousand dollars to enlarge our business, and desire to interest a party who will take an active interest either as salesman, machinist or patternmaker. Address P. O. Box 216, Lewiston, Idaho.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

INDIANA.

Technical graduate, 4 years' experience with gas and gasoline engines, wants position in drafting room or in the shop. Box 119, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 131, care AMERICAN MACHINIST.

Wanted—Position as general foreman; 14 years' experience on engines, air compressors and electrical machine work. Box 84, AM. M.

Wanted—Position by graduate, age 34, with good experience and having some money to invest if necessary. Address Box 123, A. M.

Gray iron foundry superintendent wishes to change; engines, machinery; practical in all departments; up to date; good references. Address Box 47, AMERICAN MACHINIST.

MICHIGAN.

An expert on press and die work for stamping and drawing sheet metals is open for a proposition. Box 109, AMERICAN MACHINIST.

Designing draftsman with extensive experience and familiar with modern manufacturing requirements. Address "Manufacturing," care AMERICAN MACHINIST.

Change desired by superintendent of plant employing 1,000 hands on highest grade of interchangeable work; present contract expires June 1; technical and practical training of 20 years; understands the art of getting the maximum output at a minimum cost; can install good shop system. Box 66, AM. M.

NEW JERSEY.

Any number and any kind of skilled laborers supplied at short notice. Filomeno Pelusio & Co., Box 34, Garwood, N. J.

NEW YORK.

Mechanical draftsman; 5 years' experience in drafting room. Box 117, AMER. MACH.

Mechanical draftsman, good detailer, desires position. Box 104, AMER. MACHINIST.

Mechanical draftsman having 7 years' experience desires steady position. Box 116, A. M.

Mechanical engineer, firm in mathematics and designing with cranes, hoisting and general machinery. Box 130, AMER. MACH.

Mechanical engineer, graduate of American School at Armour Institute, desires position as draftsman; $15 week. Box 70, AM. MACH.

General machinist on engines, new, and repairs; understand gas and oil engine construction; can design smaller sizes of the latter. Box 107, AMERICAN MACHINIST.

Designer—Small machines, typewriters, etc.; also tools for cheap manufacturing; presently employed; wishes position as chief draftsman or foreman. Box 94, AM. M.

Expert machinist and draftsman, age 34, at present head designer with large electrical manufacturing company, wishes opportunity to make good in leading position with small progressive firm. Box 132, AMER. MACH.

First-class draftsman on special machinery; jig and tools; redesigning for economical manufacture; 10 years' experience; 3 years chief draftsman; vicinity of N Y. or Conn. W. J., care AMERICAN MACHINIST.

Assistant superintendent or charge medium size plant; machinist; technical graduate; thorough knowledge production and costs; executive ability; general manufacturing experience; age 30. Box 111, AMER. MACH.

Mechanical engineer, gas engine expert, extensive experience in designing, testing and building of internal combustion engines, able to introduce gas engine building, wants position as chief engineer or superintendent, eventual representative. Box 124, AMER. MACH.

Civil engineer (German), with extensive experience in general machine construction and office management at European mercantile and government shipyards, seeks similar position in this country, with either public or private industrial concern. Address Box 39, AMERICAN MACHINIST.

Manager or general superintendent, capable of reorganizing a manufacturing business not earning dividends or improving present earnings and conditions; past work has been decidedly successful in the manufacture of machinery, iron, steel and brass lines; efficient methods, occupied with energy, economy and judgment; practical, technical and commercial training. Box 120, AMER. MACHINIST.

OHIO.

Superintendent of tool works seeks wider field of operation and solicits correspondence with parties in or near New York city. Address Box 108, AMERICAN MACHINIST.

PENNSYLVANIA.

Broadly qualified superintendent and master mechanic desires change; technical education; drop forge, press work, track tools; 18 years in machine shop and drawing room. Box 118, AMERICAN MACHINIST.

Cost accountant wishes change, now employed with large manufacturing company, charge costs; experienced in systematizing factory and office accounting and making piece-work prices. Box 96, AMER. MACH.

Foreman—Toolroom or shop; hustling inventive young man; wide experience on tools, metal stamping, general machinery; modern systems and methods, designer, labor and time savers; vicinity New York or Phila. Box 126, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Superintendent of engine and general machine shop desires position; traveling salesman, superintendent or foreman; wide practical experience; designer of tools, jigs and special machinery. Address Box 122, A. M.

WISCONSIN.

Position wanted by a foundry foreman who would like to make a change; a practical molder with a technical education; can mix iron by analysis and make analysis if necessary; an A1 cupola man. Box 110, AM. M.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers. Apply to Ross Rifle Co., Quebec, Canada.

Wanted—First-class draftsmen on tool and gauge work. Apply Ross Rifle Co., Quebec, Canada.

First-class operator for Landis grinder; state age, experience and wages expected. Box 86, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Good all-around machinists on

engine and general machine work; good pay and steady work. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

ILLINOIS.

Two draftsmen with electrical and mechanical experience by Chicago company; state age, education, past employers and salary expected. Box 128, AMER. MACH.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, "Patterns," Box 34, AMERICAN MACHINIST.

A thoroughly competent factory superintendent is wanted by a Chicago company manufacturing small machines; must be up on shop economies, possess executive ability and be able to get out goods; no attention will be paid to answers that do not state name, age, experience, salary wanted and give references. Box 115, AMER. MACH.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

Experienced office men, draftsmen, foundry chemist, foremen, stock, departmental and cost clerks, and mechanics for large concern with rapidly growing business, including foundry, machine shops and sheet metal and wood-working departments; high-grade work, including automobiles. Box 101, AM. MACH.

MASSACHUSETTS.

Wanted—First-class printing machinery draftsman and designer. Box 69, AM. MACH.

Wanted—Machine tool designer on patent quick-change gear lathe work only; state experience. Fitchburg Machine Works, Fitchburg, Mass.

Wanted—A first-class draftsman on small automatic machinery, tools, etc., and designing; up-to-date factory in Worcester County; state age, experience and wages expected. Address Box 46, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Mechanical draftsman; preferably familiar with hoisting machinery and cranes. Address, stating terms and experience, Northern Engineering Works, Detroit, Mich.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern and up-to-date methods. To honest, competent men who will "do things" steady work and first-class wages are waiting. State experience, age, references and full information. Cadillac Automobile Company, Detroit, Mich.

NEW JERSEY.

A few first-class planer, boring mill and lathe hands for heavy engine work. Apply to the Ball & Wood Company, Elizabethport, N. J.

Wanted—A competent mechanical draftsman for work on condensers, pumps, etc.; location near New York. Address, stating age, experience, etc., Box 114, AMER. MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—Competent designer, machine tool work; state age, experience and salary desired. Box 112, AMERICAN MACHINIST.

Wanted—Diesinker for medium-class work; one with knowledge of railroad work preferred; state age, salary and references. Box 105, AMERICAN MACHINIST.

Wanted—Three good draftsmen with mechanical knowledge to design pumps and hydraulic machinery; technical graduates preferred. Box 106, AMERICAN MACHINIST.

Wanted—Storekeeper for a machine shop and foundry in Greater New York; state fully reference, experience, age and salary expected. Address Box 127, AMER. MACH.

Stenographer and bookkeeper wanted; concern starting in steel and iron business, New York city; experience in metals or machinery preferred; opportunity for proper person. Address, stating age, experience and wages expected, "Oppidum," AMERICAN MACHINIST.

Wanted—By a large manufacturing concern located in New York, a thoroughly competent man as shop superintendent; only a trained mechanic and one experienced in handling men will be considered; state age, experience and references. W. A. R., P. O. Box 43, New York City.

A thoroughly capable, practical, experienced man (American born, not over 40) as superintendent in construction of light, automatic machinery; must be bright, clean character, and successful, with commercial ideas; man willing to demonstrate ability, understanding the control of men, discipline and system; a fine opportunity for brilliant worker; applications confidential. Box 129, A. M.

OHIO.

Wanted—Floor and machine hands; good wages; steady employment. Brown-Cochran Co., Globe st., Lorain, Ohio.

Tool and die makers and experimental workers, accustomed to small, accurate work, wanted because of permanent enlargement of toolroom and experimental departments; positions permanent and afford opportunities for advancement for first-class men. Apply or address Employment Department, National Cash Register Co., Dayton, O.

PENNSYLVANIA.

Machine and floor hands, familiar with machine tool work. Standard Engineering Works, Ellwood City, Pa.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Assistant cost and order clerk; state age, experience and salary expected. Address Box 113, AMERICAN MACHINIST.

Wanted—One diemaker and one toolmaker; only first-class workman need apply; state experience and wages expected. Address Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Experienced draftsmen in electrical apparatus, switchboards, motors and generators; only first-class men need apply; state experience and salary expected. Address Box 102, AMERICAN MACHINIST.

Wanted—Machinist to assemble engines by contract, also one to do machine work, or one man to do both; only men with experience need apply; chance for hustling man who knows how to do high-class work to make big money. Box 100, AMERCAN MACHINST.

Wanted—Assistant superintendent construction for large railway, lighting and power company; location, Middle States; technical education preferred, also several years' machine shop and construction work experience. Address answer M, care AMER. MACHINIST.

TEXAS.

Wanted—Superintendent for our machine shop, working about 30 men now, but expect to enlarge shortly; our work is general repairs on sawmill, cotton oil mill and sugar machinery engines, locomotives, marine engines and pumps; we also build new rotary pumps and other machines on orders; have no special machine line that we manufacture; our general foundry is well equipped and under capable management; must be competent to make estimates on all work, a handler of men—in fact, a first-class man. Address, with full particulars as to former work, salary, etc, Dickson Car Wheel Co., Houston, Texas.

WISCONSIN.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed. Give full experience and reason for changing. Shop experience great advantage. All letters acknowledged and held confidential. Box 80, AMERICAN MACHINIST.

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Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Wickes Bros., New York.
Toledo Mach. & Tool Co., Toledo, Ohio.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Keuffel & Esser Co., New York.
Spaulding Print Paper Co., Boston, Mass.

Boards, Friction

Ingalls & Co., Castleton, N. Y.

Boilers

Struthers-Wells Co., Warren, Pa.
Wickes Bros., New York.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Landis Mach. Co., Waynesboro, Pa.

Bolt and Nut Machinery *Continued*

Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books, Mechanical

Baird & Co., Henry Carey. Philadelphia, Pa.
Henley Pub. Co., Norman W., New York.

Boosters

C & C Elec. Co.. New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.

Boring and Drilling Machines, Horizontal—*Cont'd*

Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.

Calipers

Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Why is this

"Whitney" Hand (Feed) Milling Machine

used in preference to all others by U. S. Government, Western Electric Co., Underwood Typewriter Co., Smith & Wesson, Hopkins & Allen Arms Co., Standard Adding Machine Co., Smith Typewriter Co., leading Automobile Manufacturers, etc., etc.? Possibly it is because we make more of a specialty of Hand Millers than any other company in the world, and give our customers greater return for their investment by way of quality, quantity, range and efficiency.

PITCH	DIAMETER OF ROLL
1 in.	$\frac{5}{8}$ in.
$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.
$1\frac{1}{2}$ in.	$\frac{7}{8}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These Are **"WHITNEY" STANDARDS** For ROLLER CHAINS

The Pitch Sizes and Diameters

advance uniformly in perfect proportion. They have Broken all Records for Efficiency, and have been adopted for most of the leading American Cars, including

"Acme" "Auto-Car Equipment" "Baker" "Bramwell" "Cadillac" "Columbia" "Corbin" "Champion" "Elwell-Parker" "Ford" "Franklin" "Grout" "Gaeth" "Gibbs" "Hartford Motor Street Sweeper" "Knox" "Lenawee" "Mitchell" "Moline" "Matheson" "Milwaukee Four-Wheel Drive" "Manhattan" "Olds" "Pope-Hartford" "Pierce-Racine" "Prescott" "Queen" "Rambler" "Stearns" "Sommer" "Snell" "Thomas 50 and 60 H.P." "Tourist" "Wayne" "Western-Electric."

PITCH	DIAMETER OF ROLL
1 in.	$\frac{9}{16}$ in.
$1\frac{1}{4}$ in.	$\frac{5}{8}$ in.
$1\frac{1}{2}$ in.	$\frac{3}{4}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These are the Old or Competing Standards

The **PITCH SIZES** advance uniformly, but the **DIAMETERS** are irregular and not in perfect proportion.

All chain manufacturers have adopted "Whitney" Standards for the new sizes 1¾ in. and 2 in. Pitch.

The Whitney Mfg. Co.

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Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Quint, A. D., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Butler Chuck Co., Greenfield, Mass.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach .Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Circuit Breakers
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Clamps
Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
American Elec. & Controller Co., New York.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Electric Controller & Supply Co., Cleveland, O.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.

Cranes—*Continued*
Coburn Trolley Track Co., Holyoke, Mass.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mch. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Osgood, J. L., Brooklyn, N. Y.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Perkins Mach. Co., Warren, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

Drill Blocks and Gages
Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roos & Mill, Cincinnati, O.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn
Vanderbeek Tool Works, Hartford, Conn.

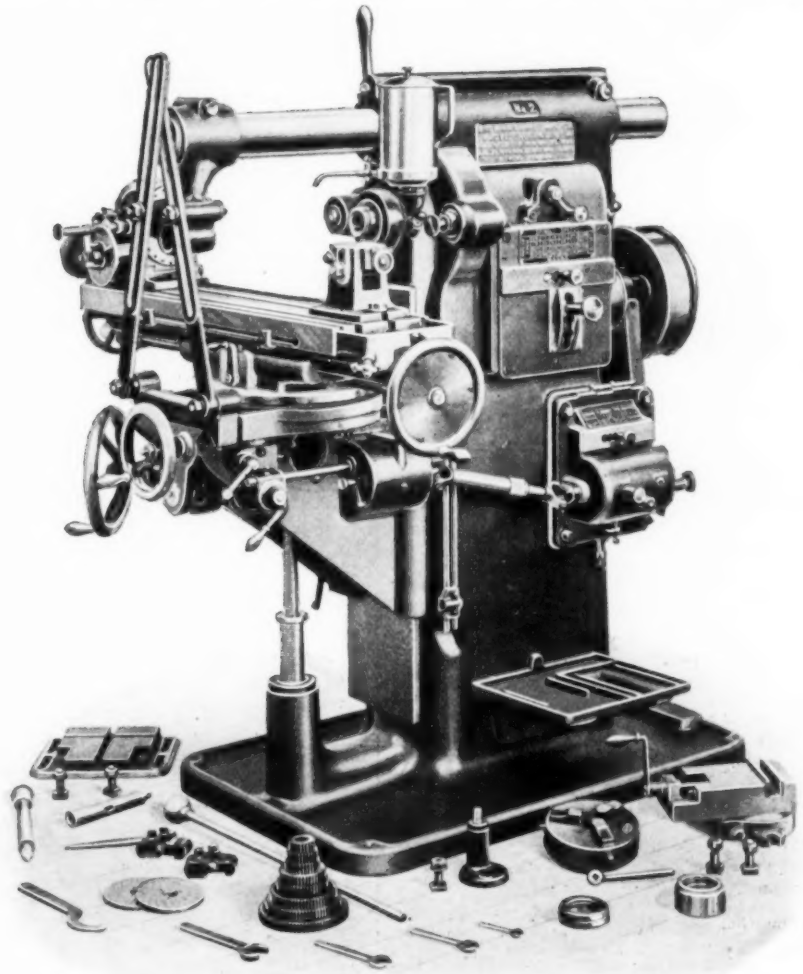
Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. F., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.

BROWN & SHARPE MFG. CO.,

Providence, R. I., U.S.A.

FULL EFFICIENCY AT ALL TIMES

an essential to Commercial Milling.



The No. 2-A UNIVERSAL MILLING MACHINE has this essential.

No Cone Pulley—Single Pulley at constant speed gives large belt contact. Full efficiency of machine available at spindle when using cutters of large diameter.

High ratio of spindle gearing.

Feeds and speeds independent and in geometrical progression. Adapted to Constant Speed Motor Drive.

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McCabe, J. J., New York.
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Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Valentine Gas Engine Co., Plainfield, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic

Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Rail

Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Spindle

Three Rivers Tool Co., Three Rivers, Mich.

Drills, Ratchet

Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors

Allington & Curtis Mfg. Co., The, Saginaw, Mich.

Dynamos

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

American Elec. & Controller Co., New York.
Clark & Co., Jas., Jr., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Clark & Co., Jas., Jr., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
Standard Tool Co., Cleveland, O.

Emery Wheels

See Grinding Wheels.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline

Abenaque Mach. Wks., Westminster Station, Vt.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil

Mietz, August, New York.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Fans, Electric

General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines

Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.

Filters, Oil

Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Baldwin Steel Co., New York.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Lang Co., G. R., Cincinnati, O.
Wyman & Gordon, Worcester, Mass.

Forming Machines

Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Gas

Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop

New Britain Mach. Co., New Britain, Conn.

Gauges, Recording

Bristol Co., Waterbury, Conn.

Gauges, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam

American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.

Gears, Cut—*Continued*

Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide

Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

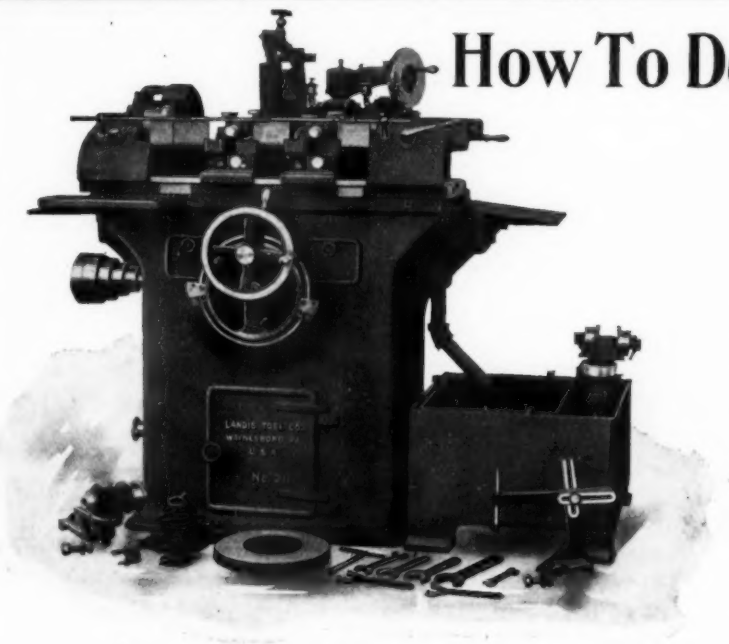
Grinders, Cutter

Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk

Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.

How To Do Better Grinding



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10-inch swing. 30 inches between centers.

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Landis Grinders have proved that old grinding methods are inadequate for present day manufacturing. They grind anything that can be revolved between two dead centers and get down to within .0001" of absolute accuracy when necessary. They produce a finish that leaves nothing to be desired.

Built in various styles and sizes for various kinds of work. Send details, or samples of work you require a grinder to do, and we'll help you make the best selection.

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CINCINNATI, OHIO, U.S.A.
VERTICAL TURRET BORING AND TURNING MACHINES

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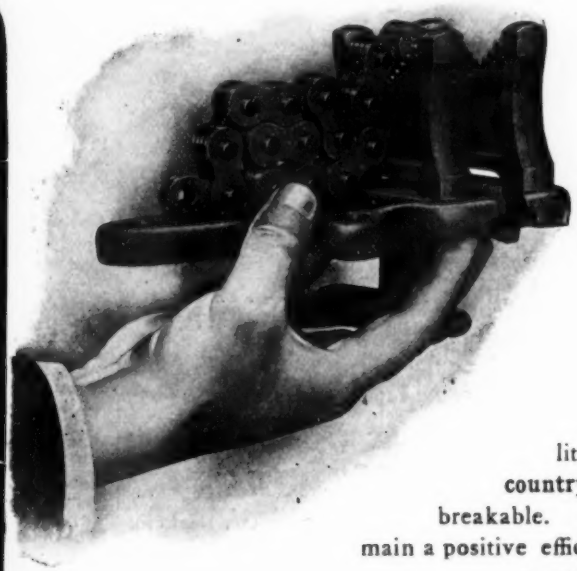

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Of celebrated Vulcan Chain Pipe Wrench kin, we hope to place this little 10-lb. giant in **every shop** of **every country** in the world. You understand: it's unbreakable. A single Vulcan Chain Pipe Vise will remain a positive efficient working wonder as long as you live.

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Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

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Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.

Hack Saw Blades and Frames—*Continued*
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Hoist, Mfg. & Const. Co., Philadelphia, Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfied Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co. J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Durbrow & Hearne Co., New York.
Fairbanks Co., New York.
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Godfrey, A. W., Boston, Mass.

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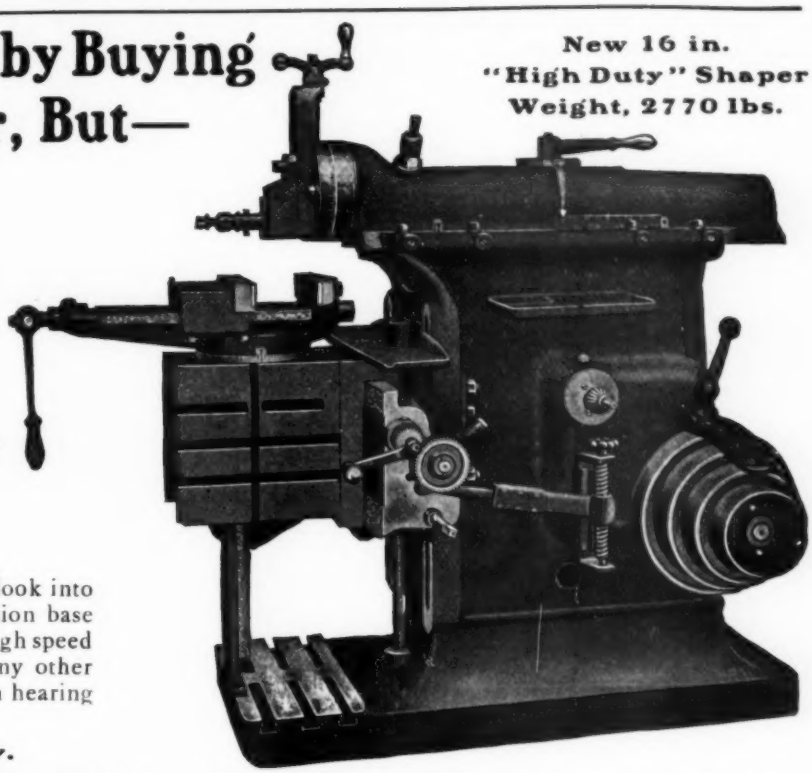
It won't be safe to spend that fifty until you're downright sure that it's money saved. The time to reckon up the savings is after the machine has gone through pretty hard service. That's the time when big figures, representing money saved, go down to the credit of



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"High Duty" Shaper
Weight, 2770 lbs.

The "High Duty" Shaper.

If you desire to know the reasons why, look into the double train gear drive, the extension base and table support, its conveniences for high speed work, its range in speed, and the many other features which we'll gladly point out on hearing from you.

The Keynote is Quality.

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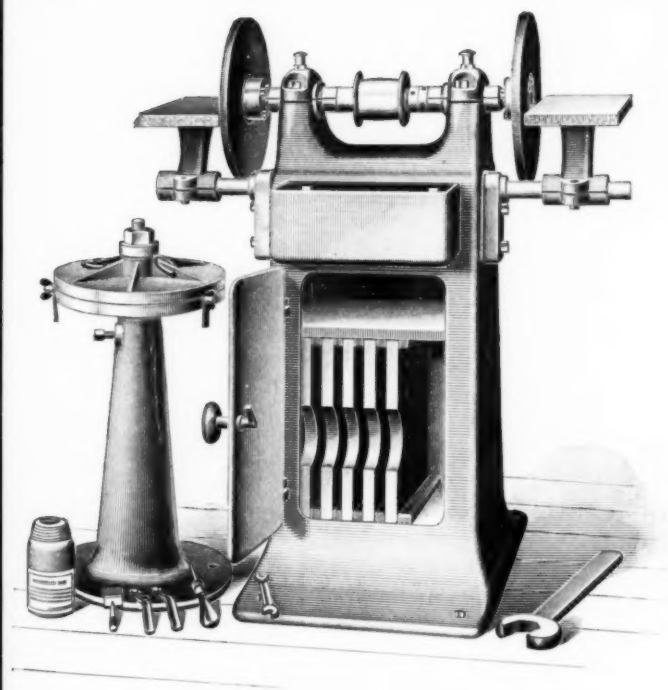

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The rapidity with which this machine cuts is surprising. The discs run 50% faster than any emery wheels and never get out of true.

These machines will make money for you. Send us samples of your work and let us demonstrate this point. We will grind them free of charge and report the time and material required.

The cut represents our Plain Disc Grinder, which is built in two sizes, viz., 14 inch and 20 inch.

Ransom Manufacturing Co.,
Oshkosh, Wis., U.S.A.

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McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicgao, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

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Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Davis Co., Frank M., Milwaukee, Wis.
Durbrow & Hearne Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

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Bemis & Call Hardware & Tool Co., Springfield, Mass.
Durbrow & Hearne Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Robson, Le Grand O., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Co., Frank M., Milwaukee, Wis.
Slocomb Co., J. T., Proviednce, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.

Milling Attachments—*Cont'd*
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Osgood, J. L., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smth Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.

Milling Machines, Vertical *Continued*
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn.
Owen Mach. Tool Co. Springfield, Ohio.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

Motors, Electric
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Numbering Machines
Bates Machine Co., New York.

Nurls
Hammacher, Schlemmer & Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oilers
Butler Chuck Co., Greenfield, Mass.

Oil Stones
Pike Mfg. Co., Pike Station, N. H.

Packing, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Jenkins Bros., New York.
Robson, Le Grand O., Buffalo, N. Y.

Packings, Hydraulic and Pneumatic
Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Pattern Shop Machinery and Supplies
Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.

Patents
Coombs, Howard A., Washington, D. C.
Mackaye, H. S., New York.

Pin and Stud Machines
Hartford Mach. Screw Co., Hartford, Conn.

Pinion Cutters
American Watch Tool Co., Waltham, Mass.
Gould & Eberhardt, Newark, N. J.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Niles-Bement-Pond Co., New York.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bilgram, Hugo, Philadelphia, Pa.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Drop
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry & Mach. Co., Waterbury, Conn.

Presses, Forging
Chambersburg Engineering Co., Chambersburg, Pa.

Presses, Hand
Perkins Mach. Co., Warren, Mass.

Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
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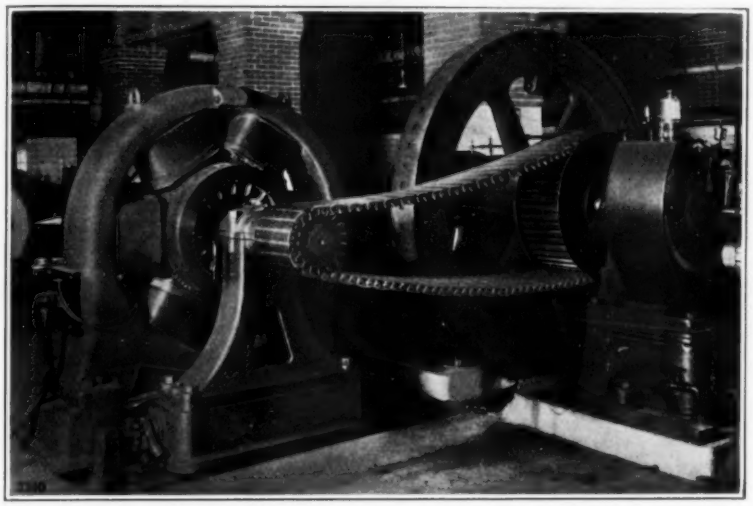

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Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
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Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Toledo Mach. & Tool Co., Toledo, Ohio.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Becker-Brainard Mill. Mach. Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.

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Patterson, Gottfried & Hunter, Ltd., New York.
Philips Pressed Steel Pulley Works, Philadelphia, Pa.
Reeves Pulley Co., Columbus, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

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Watson-Stillman Co., New York.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.

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Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
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Sutton Co., C. E., Toledo, Ohio.
Vandyck Churchill Co., New York.

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Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.

Racks, Cut—*Continued*
Simonds Mfg. Co., Pittsburg, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Racks, Tool
Massey Mach. Co., Watertown, N. Y.
New Britain Mch. Co., New Britain, Conn.

Reamers
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Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Mergenthaler Co., Ott., Baltimore, Md.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
American Elec. & Controller Co., New York.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Allen, John F., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.

Rock Drills, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Hammacher, Schlemmer & Co., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Rust Preventative
Houghton & Co., E. F., Philadelphia, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing and Sifting Machines
Gould & Eberhardt, Newark, N. J.
Obermayer Co., S., Cincin., O.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co. Birdsboro, Pa.
Newton Mach. Tool Wks, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Mich. Agricultural College, Agricultural College P. O., Mich.
Michigan College of Mines, Houghton, Mich.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

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Cleveland Automatic Mach. Co. Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co. New York
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russel Mfg. Co., Greenfield, Mass.

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry Co., Pittsburg, Pa.
Baush Mchry. & Supply Co., Springfield, Mass.

Second Hand Machinery *Continued*
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Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Era Gas Engine Co., Dayton, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Burlin, Chas. T., Whitinsville, Mass.
Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
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Nicholson & Co., W. H., Wilkesbarre, Pa.

Shafting
Brightman Mfg. Co., Shelby O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., Beaver Falls, Pa.

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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Churchill Co., New York.

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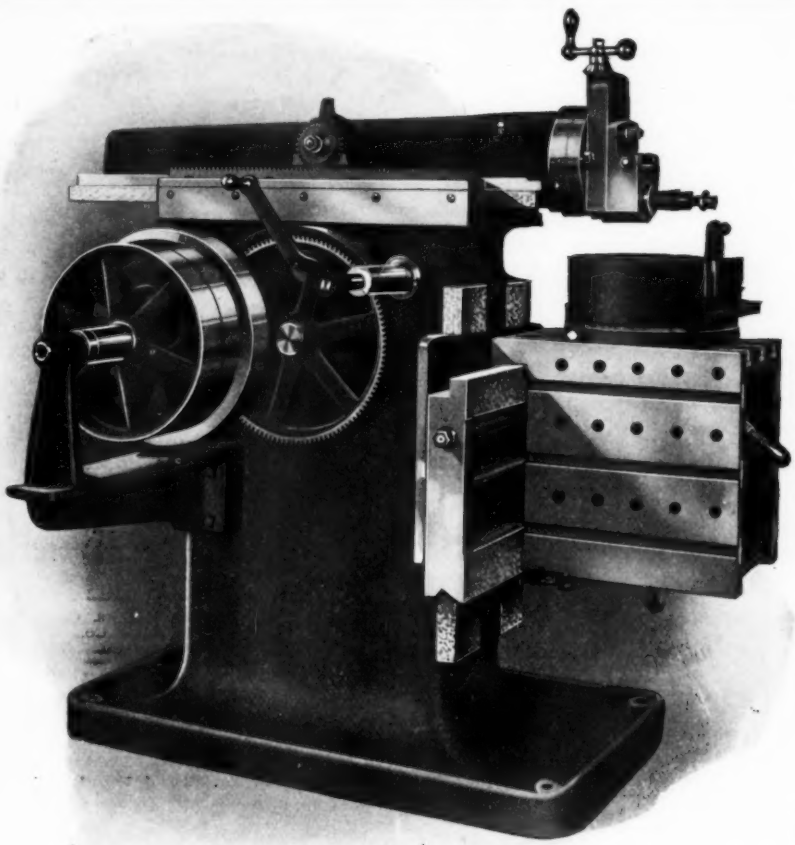
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Sutton Co., C. E., Toledo, O.
Toledo Mach. & Tool Co., Toledo, Ohio.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., Warren, Mass.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Slotters
Baker Bros., Toledo, O.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.



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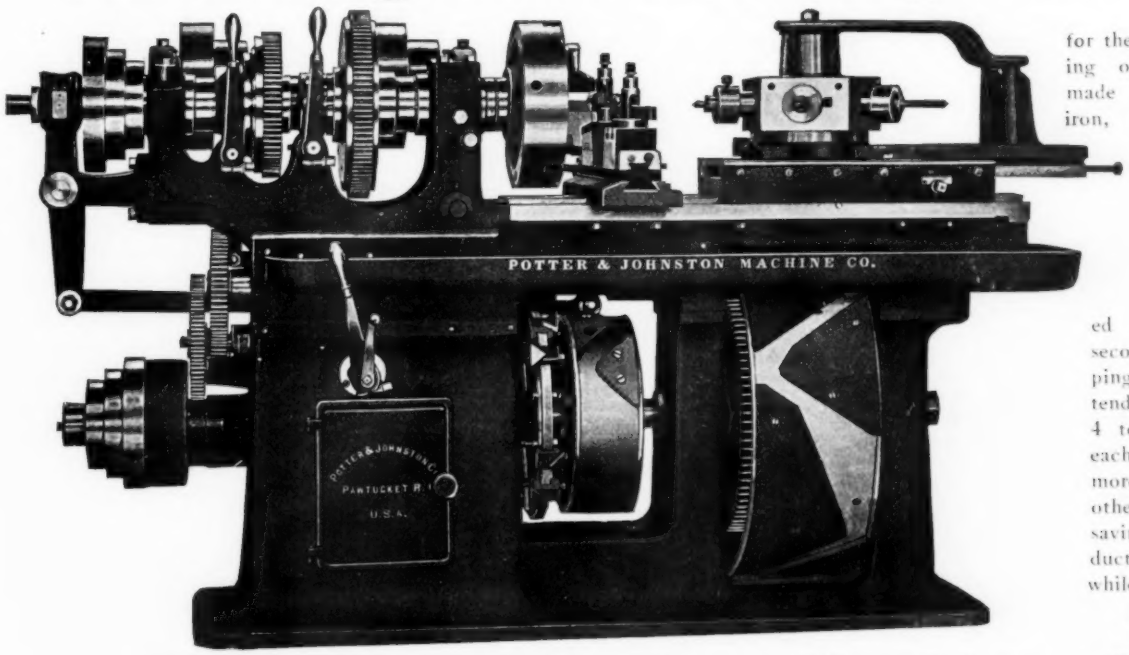

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Standard Tool Co., Cleveland, O.

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Dallett Co., Thos. H., Phila., Pa.
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Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co.. Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mechanics Machine Co., Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland. O

Stampings, Welded
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Lockwood, Arthur J., New York, N. Y.
McInnes Steel Co., Corry, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Baldwin Steel Co., New York.
Boker & Co.. Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin B., Chicago, Ill.
Lockwood, Arthur J., New York, N. Y.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brightman Mfg. Co., Shelby, O.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland, O.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Tuttle Mfg. Co., H. A., South Norwalk, Conn.
Valentine Gas Engine Co., Plainfield, N. J.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Twist Drill Co.. Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., has. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardiner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.

Tool Holders —*Continued*
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford. Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co.. Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Philips Pressed Steel Pulley Wks., Philadelphia, Pa.
Reeves Pulley Co.. Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co.. Edwin. Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn. N. Y.
Shelby Steel Tube Co., Pittsburg, Pa.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co.. Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co.. Bridgeport, Conn.
Dreses Mach. Tool Co.. Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co.. Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co.. Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co.. Hartford. Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co.. New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Universal Joints
Baush Mach. Tool Co.. Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Lewis Tool Co., Bridgeport, Conn.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Reed Mfg. Co., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co.. Bridgeport, Conn.
Lewis Tool Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co.. Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon. Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co.. Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

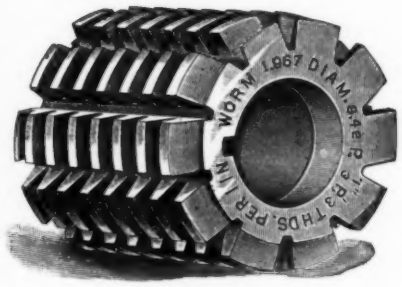
Worm Hobbing Machines
Pratt & Whitney Co., Hartford. Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co.. Hartford. Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co.. Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.



Worm Hobs.

We are better equipped to make these cutters than any shop we know of. The design of our Worm Hobs is such that the teeth can be repeatedly ground and the form never change. We make every style of Milling Cutters in use. One of the strong features of our business is making cutters to special order, being equipped to produce the finest possible in the shortest possible time.

UNION TWIST DRILL CO., Athol, Mass., U.S.A.

N. Y. Office—54 Warren St. F. M. Van Gelder, Mgr.

London Agents—Chas Neat & Co., 112 Queen Victoria St., E. C.

Diamond Chains

A well made steel chain, running on properly milled sprockets, will last much longer and prove much more efficient than a short belt. The truth of this is well demonstrated wherever milling machine feed belts have been replaced by chains. The substitution has put an end to irregular feed and other troubles. We solicit the manufacture of chains for special purposes.

Diamond Chain & Mfg. Co., Indianapolis, Ind.

"ALL OVER THE WORLD."

Universal
Tool and Cutter Grinders

Emery Wheel Machinery

Corundum Wheels

India Oil Stones

NORTON ALUNDUM, CORUNDUM AND EMERY WHEELS.

Made by
NORTON EMERY WHEEL CO.,
Worcester, Mass.

Chicago Store, 25 So. Canal Street.

When a Publisher Argues

that you ought to use more space, don't wink the other eye and figure that he is only trying to get more out of it for himself without thinking or caring where *you* come in. He *is* trying to get more for himself, but he's making an effort to get it by getting more for you. The man who knows enough to conduct a good trade paper, knows enough to know that the only way he can win for himself is to win for *you*. He studies your advertising even more carefully than you do, because you can, perhaps, get along without advertising and he can't. Without pretending, even to himself, that he knows more about your business than you do, he *does* know whether your product is properly presented or not, and he can calculate much nearer than you can, whether you can use larger spaces to advantage, because he has a hundred similar cases to judge by. The publisher with a cent's worth of business wit, knows that any temporary gain that he might make by getting an increase from you, would be very much more than offset by the inevitable cut down or discontinuance if the larger space failed to pay. The long-headed publisher will refuse business that is foreign to his line and cannot pay the advertiser. We've let some fat contracts get away, for just that reason. He doesn't want an advertiser to use space out of all proportion to the advertising possibilities of his business. He *does* want every advertiser to give the paper a fair chance by using space in proportion to the business he does or wants to do, and when he finds a million-dollar concern doing ten cents' worth of advertising, or even a small concern trying to get into a two-inch space a story that deserves and justifies a page, he very properly points out the error of so doing. The publisher is a selfish, sordid sinner, maybe; but give him credit for enough intelligence not to advise against his own best interests. He has heard the story of the goose that laid the golden egg, and while he might feed the goose on egg-producing stuff, he knows a little too much to slaughter it.

American Machinist,
505 Pearl Street,
New York

The Works of Messrs. Brown-Boveri & Co., of Baden, Switzerland.

BY EMILE GUARINI.

One of the Swiss electric construction houses which ranks among those of the most advanced type, is that of Brown-Boveri & Co., of Baden, founded in 1891 and now well known in Europe and America, owing to the results obtained with the Brown-Boveri-Parsons steam turbines which this firm has been exploiting for several years. The works cover a superficial area of about twenty-two acres, exclusive of fifteen acres which the company owns at Wettingen.

FIG. 1. GENERAL VIEW OF THE BROWN-BOVERI & CO. WORKS AT BADEN, SWITZERLAND.

ARRANGEMENT OF SHOPS.

The major portion of the land belonging to the Baden works is covered with shops (shown in the half-tones, Figs. 1 to 6 inclusive), which represent under one roof a surface of about two and one-half acres, and are divided up into fourteen bays. Work in four of these is carried on with the aid of traveling cranes of ten to thirty tons capacity. To the north a second building is intended for the construction of steam turbines. It is separated from the first building by a packing room from which the machines are shipped. At the present moment the turbine workshops comprise only three bays with a boiler house, which, for purposes of experiment, can supply steam for 1,000 horse-power.

The large traveling cranes are all controlled by electricity. They have three motors—one for raising the load, one for moving the carriage, and one for moving the crane itself. The power required by all the workshops is provided by a central hydraulic station at a distance of about one-quarter mile, and capable of normally producing 600 horse-power. This establishment also provides for the lighting and motive power required by the town of Baden. The current arrives at 1,000 volts, is transformed to 110 volts, passes thru the distribution board, and is then conveyed to the various machine shops by means of subterranean conduits. Most of the machine tools are driven in groups, the shaft for each group being belted from a motor beneath which is mounted on vertical slides arranged on one of the columns. A certain number of large machines —such as the big lathes, machines for making coils, air compressors, blast engines, etc.—are driven individually. Altogether about one hundred motors, of from 1 to 60 horse-power, are scattered throughout the works. The current generated at the hydro-electric station is not sufficient for all requirements, and is therefore added to by means of a reserve station, established by the side of the turbine shops and comprising a Sulzer steam engine, coupled direct to a generator. The works also include a reserve steam station, having three semi-portable 150 horse-power engines, each driving a 100 kilowatt generator.

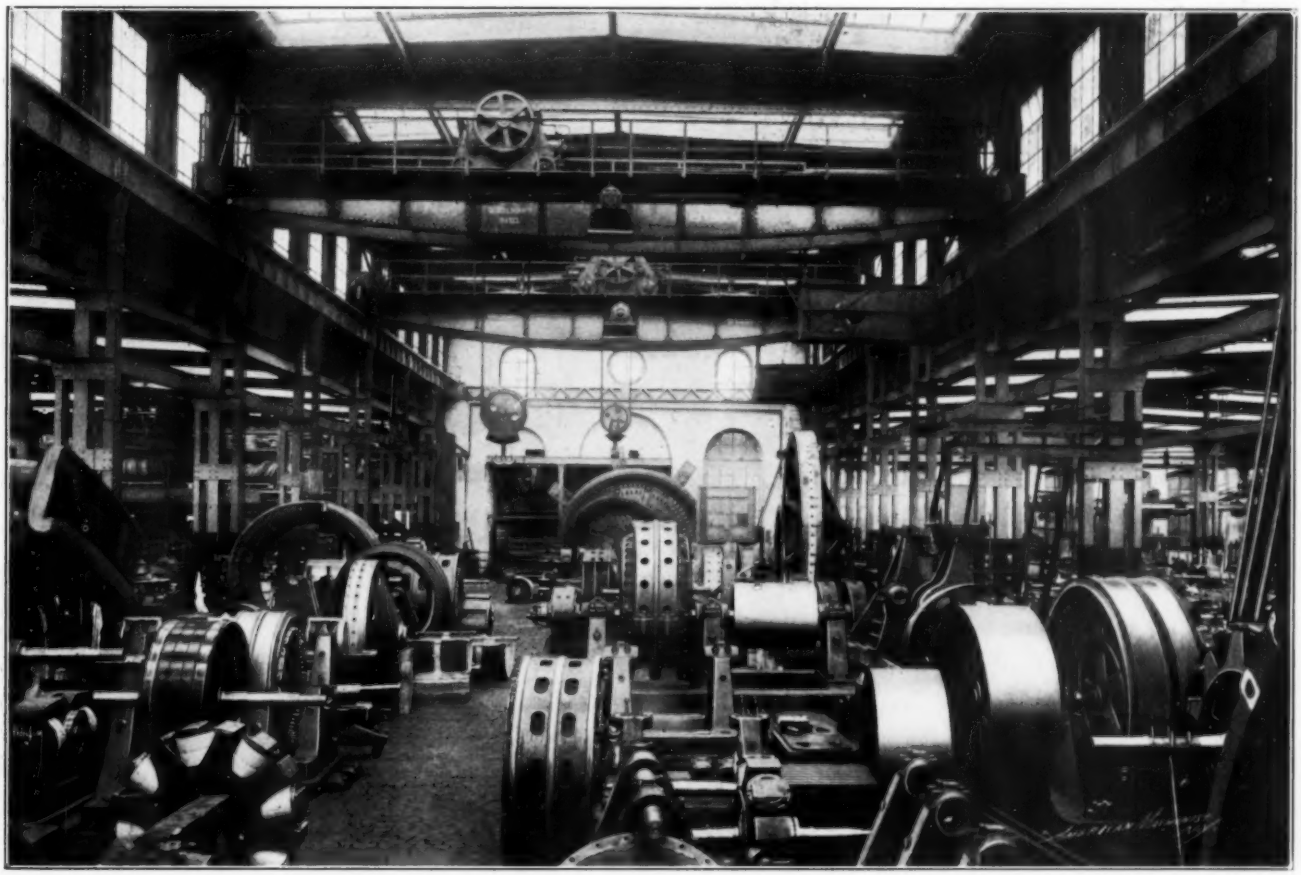


FIG. 2. ERECTING DEPARTMENT.

The four large bays have a width of 50 feet. They are reserved for building and fitting up dynamos of the largest kinds and are provided with machines, some of which are used in connection with the manufacture of armatures 30 feet in diameter and weighing 50 tons. The other bays have smaller traveling cranes and contain a large portion of the winding machines, the switchboard shops, etc.

Half of one of the large bays is occupied by the shop which is specially reserved for experiments. This shop is of the highest importance; not only are tests made here of the raw materials supplied to the firm and also of the finished machines prior to their dispatch, but it is also used for making long and exhaustive studies of novelties in constructions of all kinds. A subdivision of this shop is reserved for insulation tests under very high tensions. To this end an oil transformer enables tensions of 100,000 volts to be produced.

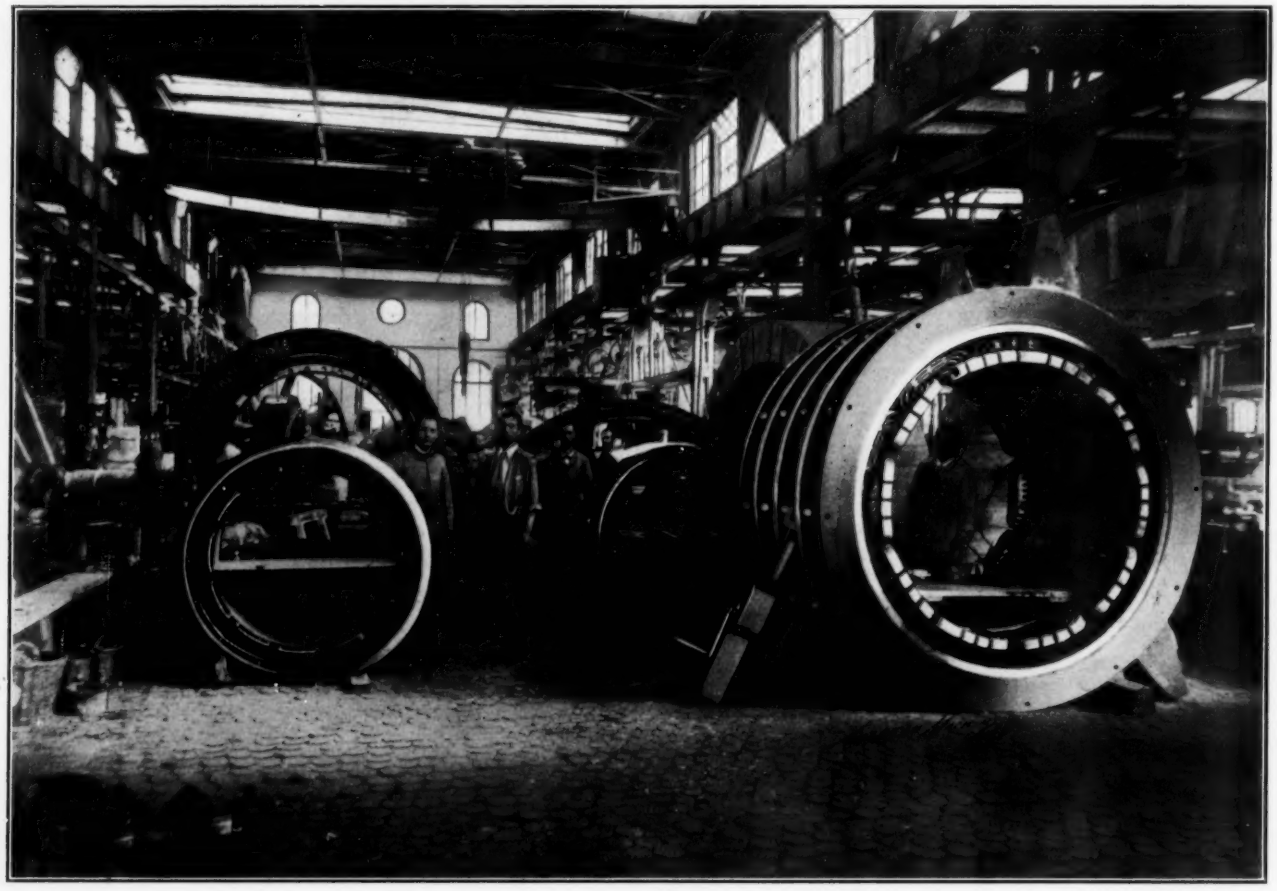


FIG. 3. WINDING DEPARTMENT.

THE TURBINE SHOPS.

One of the greatest steps made by the company since its foundation has been the construction of steam turbines. The workshops of the turbine division are situated in a special building separated from the other shops by a large department for packing. They comprise three bays 200 feet in length. The largest, with a width of 40 feet, is provided with an electric traveling crane of 20 tons capacity. In this department all the large pieces are dealt with. The two other bays, which are smaller, have a width of 30 feet, and here the small lathes are located. To the east, against the longitudinal wall, is the boiler shop, where copper coils are made for the oil tanks and connecting pipes for the turbines, etc. To the west is located a series of offices for the heads of the shops, tool stores, etc. At the northern extremity is the boiler-house supplying steam for about 2,000 horse-power for experimental purposes. The whole is completed by a plant of condensers, with a cooling tower 65 feet in hight for the condensed water.

Among the large machine tools in the main bay are a lathe taking 23 feet between centers for turning the movable portion of the large turbines and a machine for boring out the large fixed cylinders which may have a length up to 21 feet.

One of the small sections is divided into two departments, in the largest of which the rotary member of the turbine and the cylinder surrounding it are fitted with their blades. One-fourth of the portion taken up by the new shops is reserved for the experimental department, and the basement of the shops contains a complete system of piping for live steam, for the exhaust, etc., and at six different places there are openings upward so that six turbines can be tested simultaneously. At the exterior a liquid resistance has been provided which enables the turbines to be charged at will, by the aid of electric machines which are coupled direct to them. The charge is precisely determined by means of measuring instruments. The steam used for each charging operation passes from the turbine to a surface condenser, the circulating pump being of the centrifugal type and motor driven, and the air pump being likewise motor driven. The condensed water is led into one of two large graduated receptacles which are connected in such a way that when one is full measuring can be proceeded with with the other without interruption. It is thus possible to measure directly by reading the tank gages, the quantity of steam changed into water which has traversed the turbine for a given power and a predetermined period. On comparing the figures obtained for the quantity of condensed water, with the readings of the electric measuring apparatus, the output of the group in question will at once be determined.

TURBINE INSTALLATIONS.

Since they commenced operations in turbine construction, the company has built or has under way steam turbines representing a total of more than 150,000 horse-power, and a whole series of large towns —such as Frankfort, Mannheim, Paris, Milan, St. Petersburg—have been provided with turbo-generators for lighting and

power stations. In the metallurgical establishments of Roechling, at Thionville, a 600 horse-power turbine has been at work day and night for several months without interruption. Finally two vessels of the imperial German navy—a cruiser of 10,000 to 12,000 horse-power, and a torpedo boat of about 6,000 horse-power—are being made ready to use turbines for propelling purposes. These turbines are built at the Mannheim (Germany) branch, which, opened in 1899, was equipped upon the lines of the Baden establishment, and now employs 5,000 hands. For purposes of ultimate development, this branch controls land covering an area of about twenty-two acres.

POWER PLANT AND OTHER INSTALLATIONS.

The company has had much to do toward furthering the use of alternating current for transmission of power. A remarkable instance of this is to be found in the Paderno-Milan three-phase system of 15,000 volts at the terminals, without step-up transformers, and another in that of the Kander station, the lines of which have a total development of about 375 miles of wire and which distributes current under a pressure of 16,000 volts.

The plant to be installed has had to be selected in accordance with the special requirements of the case; thus, while the direct coupling of large generators to steam engines necessitated the installation of low-speed engines, the utilization of hydraulic forces with a high fall led to the installation of generating plants capable of running at the high speeds necessitated by the high-pressure turbines, which were to be coupled thereto. At the same time motors have been adopted for driving

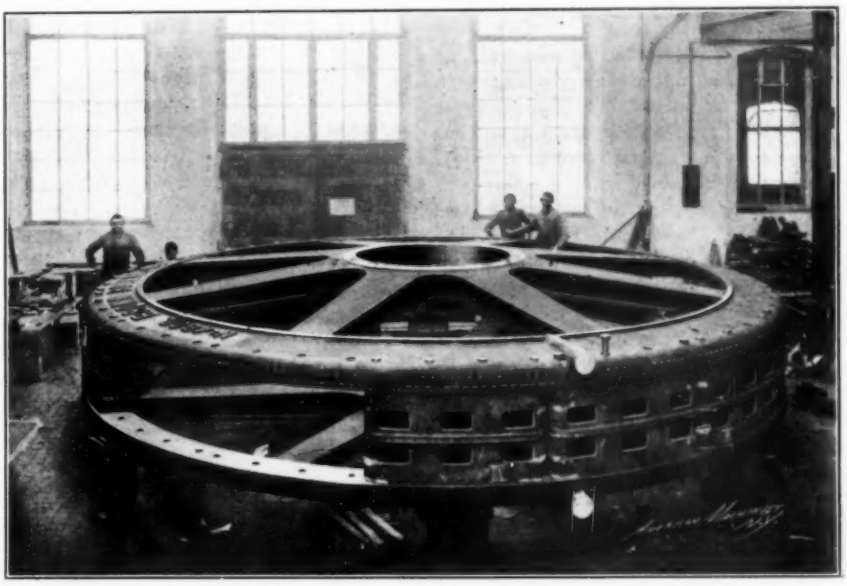


FIG. 5. ARMATURE WHEEL FOR A 1,500 HORSE-POWER GENERATOR.

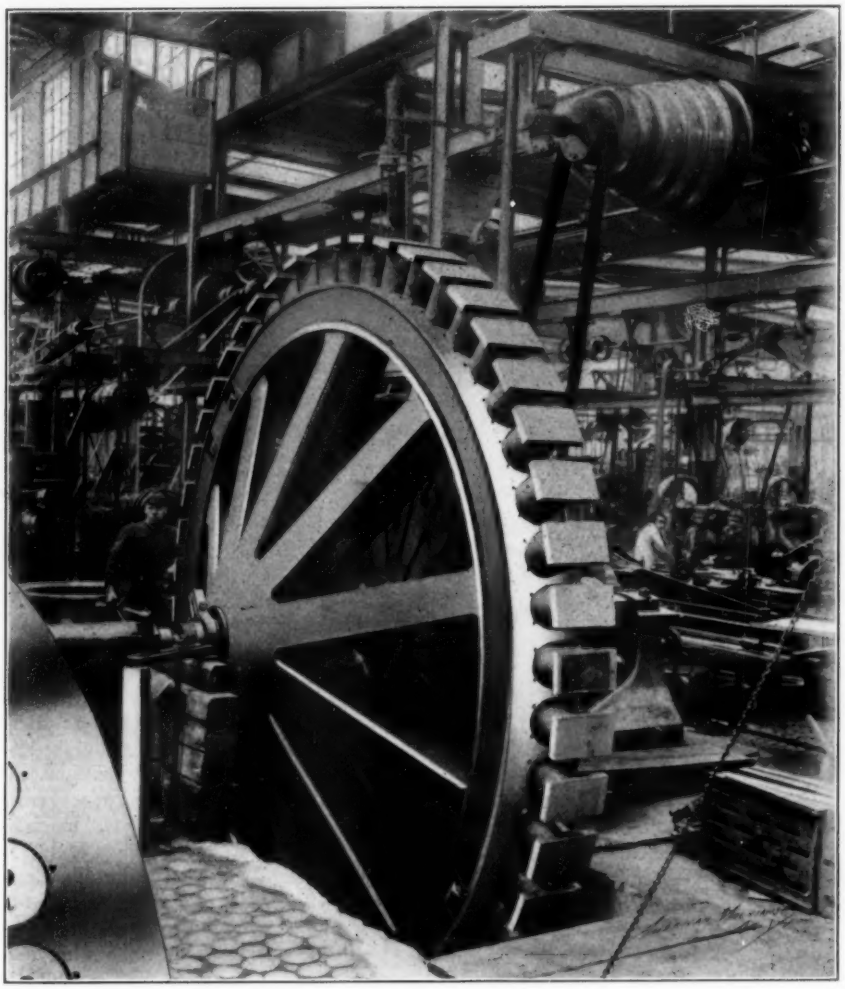


FIG. 4. LATHE WORK ON A ROTOR FOR A 1,200 HORSE-POWER INDUCTION MACHINE.

direct such machines as pumps of the high-pressure type for use in mines and the like, and it is in connection with an application of this nature that the company has had to construct one of their biggest motors. It is one of the largest asynchronous polyphase motors in existence, and is used to drive an elevator plant in the town of Geneva. It is of 1,000 horse-power and operated by a 5,000-volt current. The pump lifts the water to a hight of 500 feet and has a speed of 455 revolutions per minute. Another installation showing the application of electricity to loom driving is that at the plant of Messrs. Frua Banfi & Co., of Legnano. It comprises six three-phase motors ranging from 125 to 600 horse-power. Among installations for the distribution of power in establishments where the different points to be fed are all at short distance may be mentioned specially those in electro-chemical plants intended more especially for the manufacture of carbide of calcium. Among some of these modern applications of electricity we may mention also the installation of a series of railways operated by means of polyphase current for traction purposes either in the ordinary way or by means of the racked bar system, this company being the first to use three-phase current for such purposes.

For assuring the safety of the staff engaged in high-tension alternating-current stations, special measures are taken, and many of the most important innovations in this direction have originated in the Baden shops. The possibility of interrupting, as in the case of the 2,200 horse-power Paderno plant, currents of a tested tension of 20,000 volts shows the value of oil switches as used in this plant. The distribution boards are also a specialty of the works.

HYDRO-ELECTRIC PLANTS.

With the steam engines, groups for direct driving have been put up by this company for units amounting to as much as 3,000 horse-power. In Switzerland, Austria,, Spain, Italy and France installations of central stations of the same type have also been put up, but in these cases water power is used for driving. These installations rank among some of the most important in the world; they are arranged for direct driving of the generators, and the vertical hydro-electric groups at the central station of Olten-Aaarburg in all probability form an unique example, these groups running at a rate of only 28 revolutions per minute. One of the largest groups recently put up is that at the works of the Société des Forces Motrices du Rhône, at Lyons, and it is calculated eventually for a total of 20,000 effective horse-power. For the moment there are eight 3,500-volt generators of 1,250 horse-power each, with the requisite exciters.

GENERATORS DRIVEN BY GAS ENGINES.

Since 1896 the company has made at Interlaken some interesting experiments in connection with the coupling in parallel of a generator actuated by a gas engine to an alternator driven by a turbine; in this way was realized the transmission of 200 horse-power by means of three-phase current supplied by a group of generators with a gas engine at the works of Messrs, Cockerell at Seraing. The success obtained with these two installations has enabled a series of more important plants to be undertaken; these use blast-furnace gas engines. Among these plants we may mention that of the forges and blast furnaces of Dudelange, comprising two generators with 600 horse-power gas engines and two of 1,000 horse-power each, these machines all being intended for the production of polyphase current under a tension of 3,000 volts.

The Conditions of Milling Machine Efficiency.

The following we abstract from a recent address by Mr. Deakin before the Coventry (England) Engineering Society. When a large variety of work has to be milled, in which cutters of greatly varying sizes have to be used, one would naturally select the machines which offer the widest range of speeds and feeds. One of the greatest advances in the construction of milling machines has been to provide them with range of speed and feed which will practically give the same periferal speed of cutter, and proportionate rate of feed from the minimum to the maximum capacity of the machine. The wage cost of operating machines on general work of varying character will naturally increase, as it is only in the hands of a highly intelligent mechanic who thoroughly understands the details of a machine and the possibilities of milling that the best results can be secured. Given, however, a competent man, a good wage does not spell high cost of production, but is an unmistakable economy. There is no machine in the workshop which is so much influenced for better or for worse in proportion to the efficiency of its tools as the milling machine. The secret of its failure is immediately manifest when one sees the cutters in use engaged in a tug-of-war as to whether they shall move the material or the material will remove them. This trouble often ends in a drawn game, which when summed up resolves itself into a loss of engine power, and a condemnation of the innocent milling machine. It is advisable for foremen and managers to give more attention to the purchase and maintenance of efficient cutters for milling machines, and proper toolroom facilities for keeping them in order, as apart from these points being well attended to, milling machines will simply be a delusion and a snare. As far as the skilled mechanic is concerned, he has as yet failed to realize the opportunities for intelligent and skilled work which the milling machine affords him, and the possibilities that lie within his reach as regards remunerative employment, which the milling machine affords. It has been a too common idea among mechanics in this country that the only respectable sections of mechanical industry are those designated

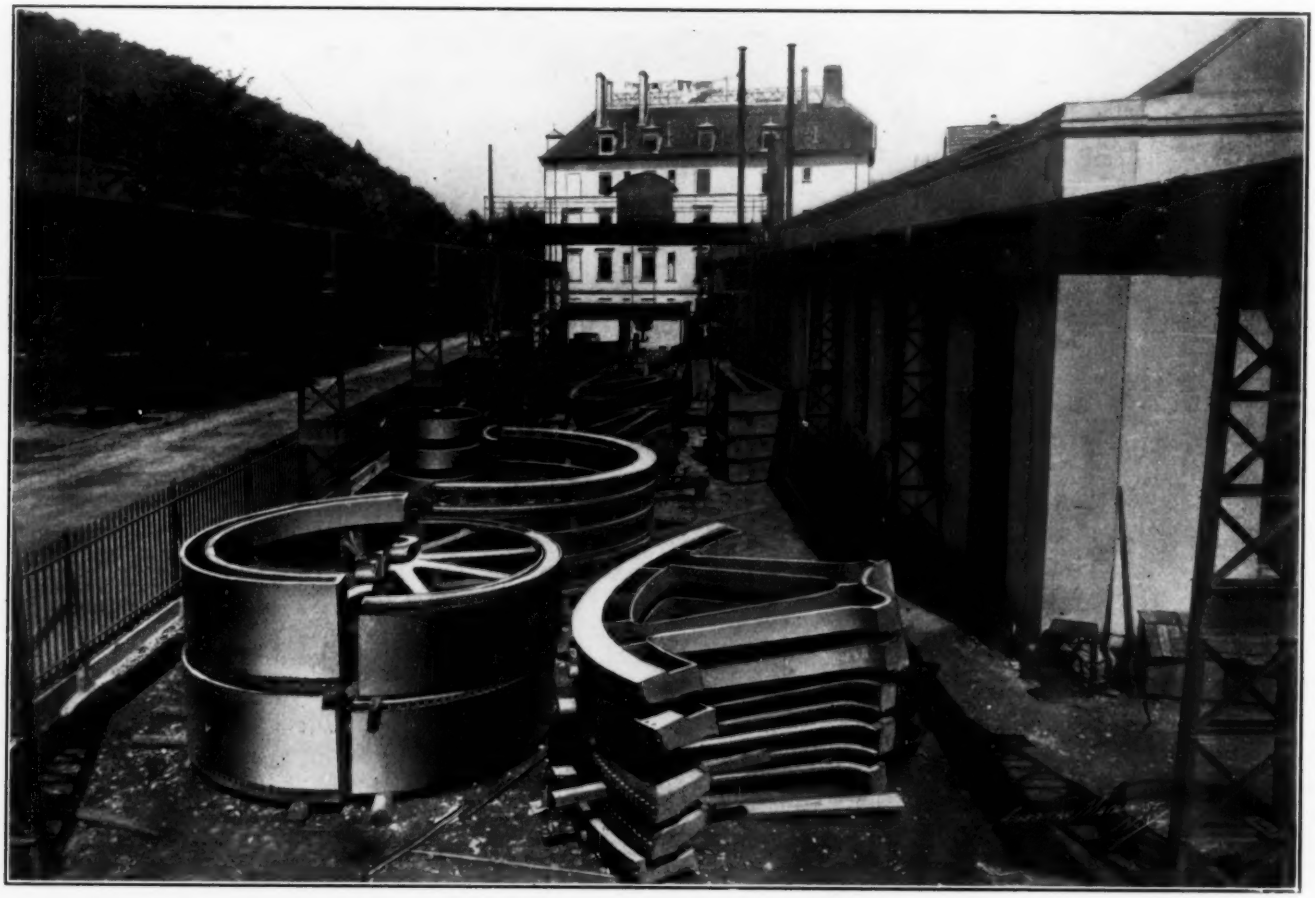


FIG. 6. STORAGE FOR LARGE CASTINGS.

by the ancient terms "fitter" and "turner," and in these connections we get an illustration of the tenacity with which people cling to old ideas and traditions. If we look back on the history of the mechanical trades, we find that the same prejudice existed years ago in connection with men who were employed on planing machines, and for a long time the leading mechanical trade unions of this country would not accept planers as members of their association.

Automatic Controller for Induction Motors.

BY WILLIAM MAIN.

The wide interest shown in the solution of Mr. Allen's "Studies in Inventive Problems" has impelled the presentation of this description of a motor controller built by the Deane Steam Pump Company, of Holyoke, Mass., and which it is believed has some novel features which will be of interest.

The problem, as a satisfactory solution of which this mechanism is presented, may readily be understood by referring to the illustrations which are from drawings by the Deane Steam Pump Company. The mechanism is a controller for a three-phase sixty-cycle General Electric induction motor, driving a Deane triplex power pump delivering water into the compression tank of a hydraulic plunger elevator.

It is required that the device be mechanical—that is, that magnets, solenoids, etc., be dispensed with—that it be automatic, starting the motor and pump when the pressure in the tank falls below a predetermined point and stopping it again when the pressure reaches an upper limit. It is further required that the starting be regularly accomplished by the closing of a three-pole oil switch in the line followed by the gradual cutting out of the resistance interposed in the motor secondary and that, when stopping the motor, the line switch be first snapped out and the resistance then again introduced. There must also be a timing adjustment in order that the speed of operation may be set so as to eliminate as far as possible the use of an excessive starting current to obtain the torque necessary to start the pump under load. Still another requirement demands that some safety device be used to insure against the reinterposition of the secondary resistance while the primary is closed.

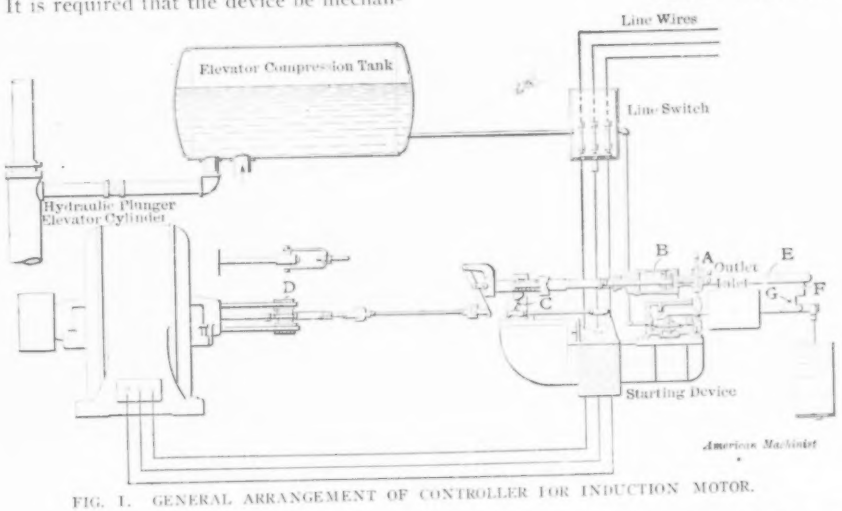


FIG. 1. GENERAL ARRANGEMENT OF CONTROLLER FOR INDUCTION MOTOR.

Referring to drawing Fig. 1, the elevator compression tank is shown connected up to the bottom side of the diafram of one of the well-known Mason belt shifters. The fluid under pressure which is used to actuate the piston of the shifter is introduced at the point marked *inlet*. The actual controller mechanism is connected to the end of the piston rod, as shown.

Assume the operation of the elevator to have caused a considerable drop in pressure in the compression tank. This decrease in pressure is communicated to the belt shifter diafram; the counterbalance weights fall, drawing down the pilot valve *A* and allowing pressure water to enter the head end of cylinder *B*, thus driving forward the piston and its attached controller slide. The first movement of this slide in the forward direction causes the long pawl *a*, Fig. 2, on the back of the slide to engage toe *b* and throw main switch lever *C*, thus closing the oil switch in the line. The further movement of the slide takes up the lost motion in the device at *D* and then cuts out the resistance in secondary and brings the motor up to speed. When the pump has delivered the required quantity of air and water into the pressure tank to bring the pressure up to normal, the counterweights on belt shifter arrangement lift, the pilot valve rises, admitting water to the rod end of the cylinder, and the slide moves back. At the first movement in this direction the last pawl *c*, Fig. 2, of the series on the outside of the slide engages the switch lever and throws out the line switch. When the lost-motion device has completed its action the secondary resistance is again interposed and the arrangement is ready for another cycle of operations. The timing of the forward movement of the device is done by the adjustment of the pilot valve in the belt

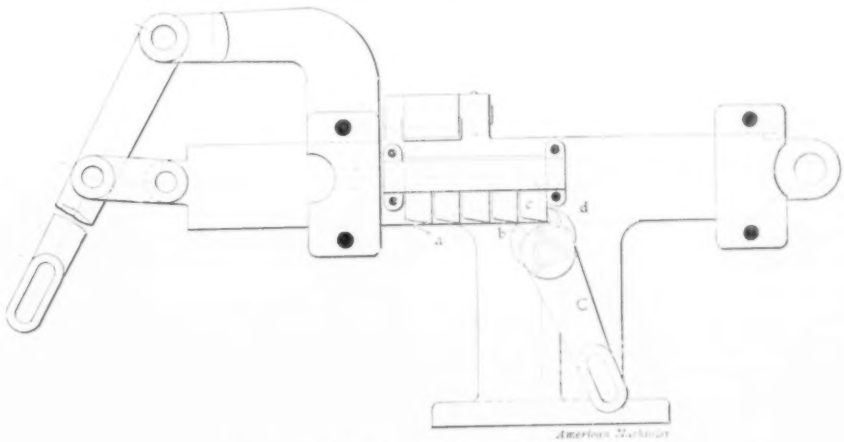


FIG. 2. DETAIL OF SWITCH-OPERATING DEVICE.

shifter to admit the water slowly or rapidly, as required.

In order to prevent the possibility of introducing resistance into the motor secondary while the primary is closed, as might occur if the pressure in the elevator tank should rise to its limit and throw the pilot valve before the piston had completed its stroke, the series of pawls is provided on the front of slide, as shown. No matter at what point of its travel the slide reverses one or another of these pawls is in position to open the line switch previous to any possible manipulation of the resistance. It will be understood that during the outward movement of the piston the outer pawls ride over the toe of the lever *C* by reason of the chamfered edge *d* and drop into place ready for action as they pass the toe.

While it is essential that there be an arrangement by which the speed of starting up may be accurately adjusted, it is also necessary that the complete return stroke be accomplished in as short a period as possible, so as to get back into starting position. This has been nicely accomplished by the scheme shown in Fig. 3. A yoke surrounds the cylinder and has an extension *E*, Figs. 1 and 3, carrying a pawl *F*. In the extreme outer position of the piston this pawl is so located that its sharp end is just in line with the sharp end of piece *G* riveted to the counterweight lever of the belt shifter. Any lift of the counterweight lever starts the pis-

ton on its "in" stroke, when pawl *F* engages *G* and thus raises the counterweight lever and its attached valve, opens the valve wide and thus insures the completion of the "in" stroke in the minimum of time.

This apparatus has proven itself practicable by continuous service with no adjustment or renewals for almost two years, and has given excellent satisfaction.

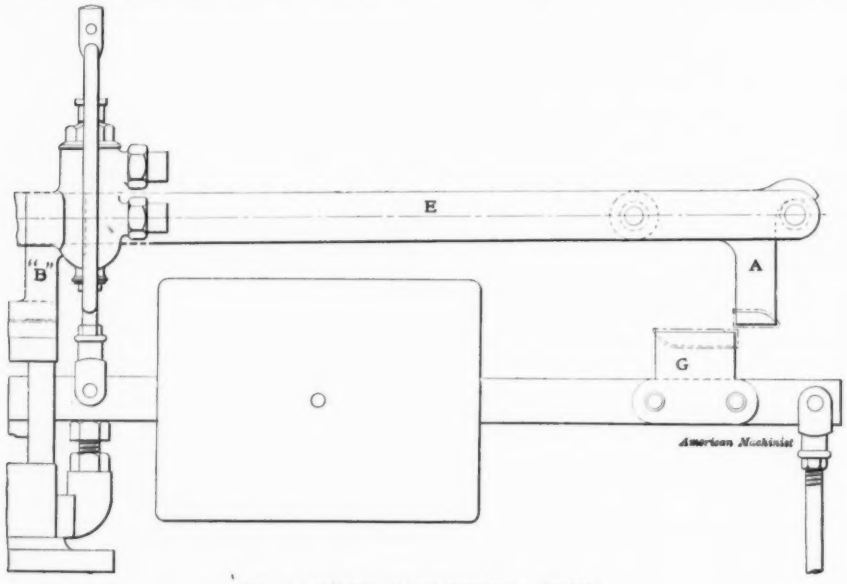


FIG. 3. QUICK VALVE-OPENING DEVICE.

Fireless Cook Stoves.

If half of what is said in a recent issue of the *Daily Consular Reports* regarding "fireless cook stoves" and based upon an address by Mrs. Back, wife of the director of an industrial school at Frankfort, Germany, is true, the device which she describes is a very important one. It seems to be a means by which, when things that are to be cooked are brought up to the boiling temperature, they may be kept at very little below that temperature for hours, and that when so kept they will continue to cook, the net result being that vegetables, meats, etc., which ordinarily would require to be kept over a stove for hours, may be kept on the stove for a few minutes only, after reaching the boiling point, and will then continue to cook after they have been removed from the stove until thoroughly done, and of course without the combustion of any more fuel. The device consists of a heat-insulated box, which seems to go by the name of a "hay box," because hay is preferably used for the insulating material. It is adapted also to the carrying of meals by or to workmen, and is declared to be capable of keeping food hot from the morning hour until the noon hour, or even longer.

Jackson (in Machine Design)—Have you worked the Army and Navy problem?

Johnson—Which problem do you call the Army and Navy problem?

Jackson—The one about the "arms and naves" of pulleys.—*Rose Technic.*

Some Western Shop Notes.

BY F. A. STANLEY.

During my recent visit to Rock Island and vicinity I dropped in one afternoon at the shop of the Moline Tool Company, whose manager, W. P. Hunt, as our readers well remember, gave us some little time ago an interesting description of a practical apprenticeship system as adopted in that shop. As I anticipated, there were quite a number of interesting features to be seen, for besides a line of gang drills the concern builds a variety of special machines which are entirely different from anything ordinarily handled in the usual tool shop.

A CONVENIENT DRAWING TABLE.

Mr. Hunt believes in the Universal drafting machine, and uses one in connection with a convenient and inexpensive drawing table of his own design, which is shown in Fig. 1. This table, as will be noticed, is carried by a pair of gray-iron supports of triangular form which are connected by tie rods, the table being pivoted at the front edge, while it is supported at the rear by two slotted straps or links which in connection with a clamp handle on a bolt passing thru frame and links form a means by which the board may be held at any angle desired. It is obvious that with this construction the front edge of the board remains practically at a certain hight from the floor regardless of the angle at which the table may be set.

A number of removable boards—all 20x30 inches in size—are used with the table, thus several drawings may be carried along without removing them from their boards. Each board as required is pushed up against a ledge at the left-hand edge of the table and secured there by a small button. The drafting machine is attached to a block of the proper thickness to carry it flush with the board face and this block projects from the corner of the table, so

FIG. 1. A DRAWING TABLE.

that the entire surface of the board may be used if necessary. The table is nearly double the size of the boards and the space to the right which is lower than the drawing by the thickness of the board forms a

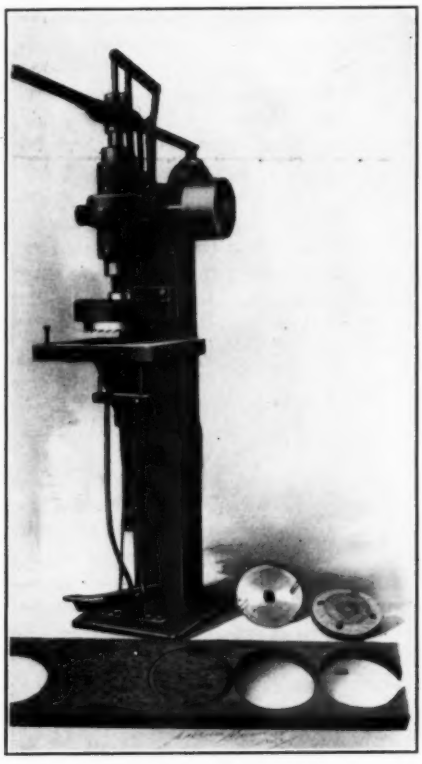


FIG. 2. MACHINE FOR SAWING OUT WASHING MACHINE HEADS.

very handy place for laying out general drawings while detailing, etc. Under the table, near the right-hand end, there is a sliding tray or shelf for note books, and two shallow drawers are provided for holding instruments, sketches, etc.

MACHINE FOR MAKING WOODEN WASHING MACHINE HEADS.

In Fig. 2 is illustrated a special machine built by this company for sawing out cylindrical heads or dasher-blocks used in washing machines. The machine in general resembles an upright drill, but has in place of the chuck a cylindrical saw, while the hollow spindle to which the latter is secured carries a plunger for clamping the work. The plank from which the disks are to be cut is slid across the table and a movement of the foot treadle then throws up a pair of spurs which engage the under side of the plank, the plunger in the spindle descending at the same time and holding the work fast until the piece is cut out. As the saw passes thru the wood, a set of knives carried by a spider inside the head bevel the upper surface of the disk.

The disk is later bored at the center and at four points near the perifery, as indicated in the photograph, the holes being put thru at an angle in a multiple spindle machine whose spindles are inverted and operated under a table to which the disk is clamped, the tools reaching the work thru openings drilled in the table.

A SCREW-DRIVING MACHINE.

The machine in Fig. 3 is known as an automatic screw driver and is made for use where a large number of wood screws are to be set in work which is of such size and form as to be conveniently handled on the machine table. It is also adapted for light drilling and wood boring operations, the screw driver in such cases being replaced by a chuck. The screws are thrown into the rotating magazine at the left of the spindle and feed automatically down a curved tube leading to the jaws of the driver at the bottom of the spindle. The foot treadle forces the screws down to the spring jaws and into the work and, as the operator has both hands free to manipulate the material, he can drive the screws home with great rapidity.

The spindle of the screw-driving machine, like that of the saw in Fig. 2, is driven by means of spiral gears, of which a great many are used in this shop; in fact, all their gang drills—which are made in various sizes and with spindles ranging as high as thirty or more in number—are driven with a similar arrangement of gearing.

The Biggest Paper Machines.

The widest paper machines in the world are to be built by the Pusey & Jones Company, for the new newspaper mill of St. Croix Paper Company, now being built on the St. Croix river in the State of Maine. Following is a brief description of the two machines:

Fourdrinier parts will be 166 inches wide, suitable for Fourdrinier wires 70 feet long and 164 inches or 165 inches in width; couch rolls 26 inches and 28 inches diameter, 166 inches face; three presses; thirty-two dryers for each machine, 48 inches diameter; one ten-roll stack for calendars for each machine. The paper will be wound in rolls, ready for the printing presses, on a patented two-drum winder, capable of making a finished roll of paper weighing three tons.

The combined weight of these two machines will be about two million pounds.—*The Paper Mill.*

A new method of casting alloys has been patented by J. Eaton Shore, works manager with Willans & Robinson, Ltd. The method referred to creates a perfectly homogeneous material, no matter what the alloy may be. White metal, phosphor bronze, gun metal, and yellow brass alloys when treated have shown tensile strengths of 50 and up to 100 per cent. greater than the same alloys when untreated. Bearings which have been in use for a long time, when made of alloys treated by this patent method, show a remarkably polished and burnished surface, and it has been proved that there is a remarkable difference in the coefficient of friction between bearings cast in the ordinary way and bearings treated in this manner.—*Mechanical Engineer,* London.

Echoes from the Oil Country—What is a "Commercial" Horse-Power?

The superintendent had a worried look on his face as he came up to the erecting floor and stopped by Billy. Billy was responsible for the final work done on the largest engines the firm built.

"What in the world do you suppose is the matter with that 14x18 engine you put out?" and without waiting for an answer he went on: "They have sent us a letter saying that it is no good. They say it knocks like as if it was going to fall to pieces whenever it is working any, but runs all right when it hasn't anything to do."

This was one of numerous sizes of engines built by the firm, and it was called by them a 40 horse-power. The fitting and testing on it had been done by Billy. It is not known who was responsible for the design, which was of the then common box-bed type with the cylinder bolted on by a flange on one side and by studs extending down from the outside of the steam chest on the other side. The holes on the one side were made for driven bolts, while the holes in the bed on the side where the studs came were enough larger to let the studs go thru easily. The slides stood up from the bed several inches, and so did the pillow block. The engine was a side draft and was being used to run a sawmill some eighty or more

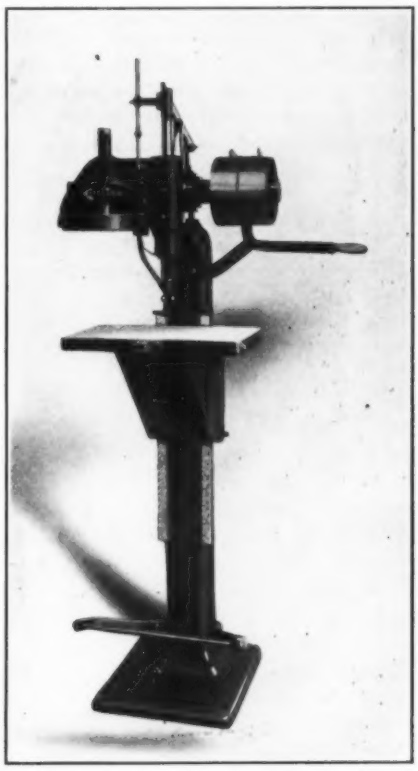


FIG. 3. SCREW-DRIVING MACHINE.

miles away from the shop. That was farther than Billy could see and come to any definite conclusions as to what the trouble might be, and so he was directed to take the first train and go and make a thorough

examination and put everything into first-class shape.

When he arrived on the ground he found that the engine was running 225 revolutions, that the boiler, which stood close beside the engine, carried 125 pounds of steam, and that the steam pipe between the two was of ample size. The engine, when not sawing, was controlled by a governor, but this governor was arranged with a sawyer's lever so that by pulling a wire the governor valve could be pulled wide open. This was used when the utmost power and speed were wanted, which was when the main saw was in the log; and this was the time that the engine hammered. One of the complaints in the letter was that the nuts on the studs that helped to hold the cylinder to the bed had not been tightened properly, and Billy had taken along the wrench that fitted them. He found them loose, and he also found that after he had tightened them as tight as he could with a piece of pipe on the end of the wrench, they would be loose again before very many logs were sawed up.

Billy's experience with this size of engine had been limited to the work he had done on it in the shop, and he was quite a bit surprised to see how it behaved when at work in the sawmill. There was the usual lot of machinery in the mill besides the main saw, and there was also an incline up which the logs were drawn from a pond. The engine did not give any trouble as far as power went, and ran very quietly, except when the main saw was in the cut, and when the full load was on it pounded badly, and as Billy sat down beside it and watched first one part and then another he found that the bed was being badly sprung. The movement of the cylinder seemed to be limited only by the amount of slack there was in the holes in the side of the bed, while the pillow block went the other way in spite of any holding down of the foundation bolts, until it looked as tho the bed must surely break.

After he had exhausted all his skill in trying to make the engine run to the satisfaction of the owners, with very indifferent success, he began to figure on the power it was developing. He had to guess at the mean effective pressure, but he thought it could not well be less than one-half the boiler pressure. On this basis he figured out that it was doing about 200 horse-power, with the possibilities quite a distance above even that.

When he ventured to tell his conclusions to the mill men he was met by a flood of statements as to the small amount of power it took to run the various things being run. It would seem that the ¾-inch chain that pulled the logs up from the pond broke only to be friendly, and that the 15-inch belt running from the 8-foot band wheel on the engine only squealed for the extra pressure of the tightener because of a desire for closer acquaintance. A lever under control of the sawyer enabled him to increase the pressure of this tightener at will.

Billy felt quite sorry that he did not have technical knowledge enough to figure out the exact amount of power it did take to run each piece of machinery in that mill, and also powers of language enough to prove that his figures were right. He did the best he could to convince the owners that while this engine might not be all that could be desired as a 200 horse-power engine, it was a world beater for a 40 horse-power and for an amount far beyond that, and that a man should not expect too much beyond what he had bought.

"But we bought this engine to run this mill, and the makers of the sawmill say that they are being run everywhere with 40 horse-power engines."

"Even if you can run the saw with 40 horse-power, you have a lot of other things hung on. You have some things in here that I never saw before."

"Oh, well, you can't count every little thing about a mill. No one pays any attention to them. They don't take any power worth speaking of. The big saw is all that needs to be figured on. Besides, see what an advantage we are giving this engine by running it so fast. The trouble is, they put a 40 horse-power cylinder on a 20 horse-bed."

Billy was well convinced that under the conditions the cylinder was the strongest part of the combination, and finally left without having made things altogether satisfactory. He carried away with him the feeling that every one about that mill considered that it was his fault that the engine did not suit.

When he got back to the shop and reported he was sat down upon quite hard, and more than ever he was made to feel that he was a very poor sort of a mechanic. Some of his fellow-workmen had quite a little sport because of his ideas of horse-power. They knew that it took a 20x30 engine to be 200 horse-power. "Why, it is marked right on the drawing," as one of them told him.

So thoroughly was the superintendent convinced that Billy had overlooked some point that he took a trip to the mill himself, and after he came back there was some correspondence with the makers of the mill as to the power required to do the work that a mill of such a size would do. Finally, one of the owners of the engine shop, in connection with one of the owners of the mill builder's shop, hired an expert and went to the mill with him. Before they got thru with their investigations it was admitted that the engine was doing considerably more than 200 horse-power. Just what kind of a settlement the interested parties made, Billy never knew; but he often wondered about what would be right in the matter.

The engine was made and sold as a 40 horse-power and there was no evidence to show that it would not deliver that power without knocking or springing. When it was crowded up to five times its rated capacity it did not do as well, but still it hardly seemed reasonable to crowd any engine so much beyond its rated capacity.

Right in here came another consideration. There was no doubt that most steam engines were crowded away beyond their rated capacity in sawmill work, and this being the case, what would 40 horse-power stand for in the trade? To put it another way: Suppose that a certain sawmill frame, which took a 60-inch saw that ran at 600 revolutions per minute, was used with a 4-inch feed and would saw the largest hemlock logs that it could reach thru; suppose that doing this alone it was said to take a 30 horse-power engine and was called a 30 horse-power mill. If the accurately measured power consumed to run such a mill doing its hardest work was 75 horse-power, would 75 horse-power of actual work be a fair meaning for the trade term 30 horse-power? It is of course assumed that the mill in question was a standard one, well known in lumber regions, and that so also was the so-called 30 horse-power steam engine that was used to run it.

The mechanical engineer who has never been up against this kind of thing may wish to dismiss the entire matter by asserting that the only proper way to do is to talk of a real horse-power; and that would be all right if he could educate the entire world as to what the term meant, and could make uniform all of the conditions under which the rating was to be done, and then could exterminate everyone who would not conform to his way.

In a catalog of a manufacturer who is known all over the United States I find a list of steam engines. It gives cylinder sizes, speeds and horse-power, and by it I find that the revolutions as given would give piston speeds of from 300 to 350 feet per minute. Allowing that the mechanical efficiency is 80 per cent., the rated horse-power at the speeds given would call for a mean effective pressure of from 28 to 43 pounds per square inch. The usual boiler pressures under which they are used range from 80 to 125 pounds, and a piston speed of 600 feet per minute is quite common. With that piston speed and with 50 pounds mean effective pressure the sizes from 20 to 30 horse-power will do nearly as well.

As these engines are made to cut off at about two-thirds stroke, it will be seen that even double these powers is not an impossibility with them under favorable conditions. Even where the conditions are unfavorable they will often do much more than one would suppose from their rated power.

Many an electric motor of the same rated power as the engine it had displaced has been made to look like the proverbial

thirty cents trying to do the work that the engine did without trouble, and this in spite of the fact that the voltmeter and ammeter showed that the motor was carrying a large overload. After a man has put in a water motor that is guaranteed as to horse-power and as to the amount of water it will need to develop the same, his water bills are apt to teach him something, even if he has power enough to do the work. His first thought is apt to be that the maker of the water motor lied about the amount of water it needed per horse-power.

To show that this horse-power matter is not as thoroughly understood as it might be, even among those in the business, I will tell of an experience that I once had. A man who was not a mechanic came into possession of a machine shop. The work of the shop was building steam engines. Among the engines sent out was one so-called 20 horse-power, of which the owner complained. He said it was "weak." Shop talk was as yet sort of vague and misty to the new shop owner, but he thought his best way was to put up a bold bluff, and he declared that the engine was one of the strongest of that size they had ever built, and that on the testing block it had actually developed 22.7 horse-power, showing more than .2 horse-power better than the next higher one. As the other fellow was still more ignorant than himself the bluff went in that case, but he felt it was a very close call and wanted me to tell him if he was safe in making such high claims for his engines. As I felt that I would be safe in saying that they would do 50 brake horse-power, I told him I did not think he was going beyond what was the truth, but that as he seemed to want to be quite exact, it might be a good thing to rig up a simple brake and really test a few of them and know what they would do. I am not at all sure that he had any idea of what a horse-power meant even after his talk with me.

W. OSBORNE.

An Accurate Sectional Blanking Die.

BY WILLIAM DORAN.

The press tools here illustrated are for punching small tool-steel blanks 1-16-inch thick, which afterward form part of the space band used in all Linotype type-casting machines. The tools are of accurate construction and produce three blanks at a time.

In Fig. 1 are shown a plan and an end view, respectively, of the die assembled. *A A* is the gray-iron bolster in which the die sections *B B* are dovetailed and fastened by filister head screws *D* and dowels *L L*. The dotted lines from *E* to *E* show where the sections interlock. *C C C* are the blanking dies proper. The manner in which the die sections *B B* are constructed to interlock at *E E* insures a rigid and strong composite die which will maintain a perfect alinement with the punches and obviate all tendency to shear during its life. The die sections *B B* are exact duplicates of each other, making it easy and convenient to work out, to grind or to repair the die.

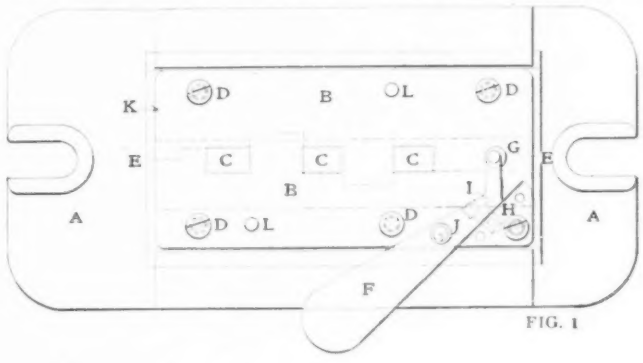
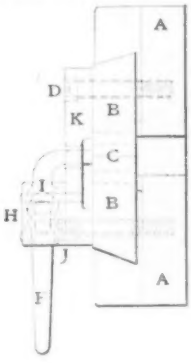
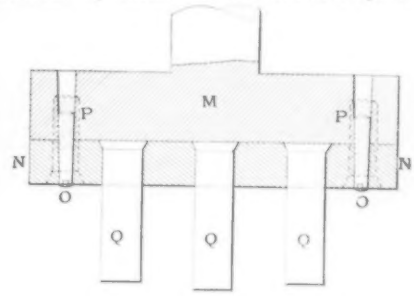


FIG. 1





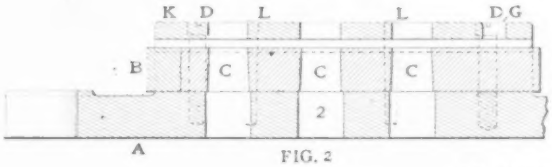


FIG. 2

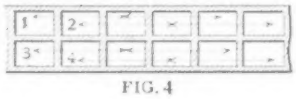


FIG. 4

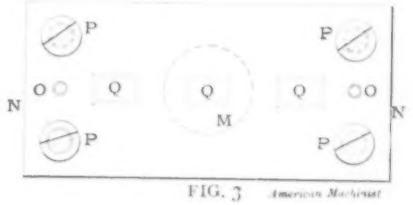


FIG. 3 *American Machinist*

AN ACCURATE SECTIONAL BLANKING DIE.

In the plan and end views can be seen also the stop for regulating the feed of the stock after each stroke. *H* is a block fastened to the top of the stripper *K*, *I* a screw which adjusts the stop *F*, and *J* a small spring which keeps the end of the stop at *G* against the die face. With this stop it is not necessary to raise the stock when feeding after each stroke; all that is required being for the operator to press down on the extended end of *F*, and after giving the stock a push forward to let go, when the stop locates the stock in position for punching.

In Fig. 3 are a vertical section and a plan of the punch. This comprises the usual gray-iron stem or holder *M*, a machine steel pad *N N*, located and fastened by two dowels *O* and four flat head screws *P*, and lastly three tool-steel punches *Q*. The central punch is made a little more than one thickness of metal longer than the other two, so that the stock will be worked upon successively, and also so that the central punch will have punched its blank and entered the die before the other two engage the stock, thus locating it positively and preventing warping and uneven spacing.

Fig. 4 shows a portion of the stock as punched. It comes to the press in long strips and of sufficient width to allow of punching two rows of blanks. It passes over the die four times. At the first passage the three blanks shown on the line starting at 1 are punched, at the second blanks on the line from 2, at the third blanks on the line from 3, and at the fourth those on the line starting at 4.

The application of variable-speed motors to planing machines in the electrical manufacturing shop of Vickers, Sons & Maxim has been a conspicuous success. The great disadvantage of planing machines has always been the fact that the speed of working is practically fixed, whereas by means of the variable-speed motor it is possible to increase the cutting speed of the tool from, say, 15 to 50 feet per minute. The strong point is that the return speed of the table is always kept at its maximum value. Vickers, Sons & Maxim are converting sixteen of their largest planing machines from the old-fashioned belt drive to the electric system. With this system the motor on the cutting stroke runs at its slowest speed, and, at the end of the stroke, the motor reverses automatically. As soon as the reversal has occurred a resistance is automatically inserted in the field winding, quickly raising the speed to 900 for the return stroke. At the end of the quick-return stroke, immediately before reversal, the field resistance is short-circuited, providing a strong field for reversing in, and the motor reverses and makes its slow-cutting stroke, the cycle repeating itself. The insertion and removal of the field resistance necessitates a special form of switch.—*Mechanical Engineer.*

Cooling Water for Condensers.

BY ERNEST R. BRIGGS.

One of those unaccountable rules whose correctness is of the doubtful order, and whose origin is a myth, has been preserved in the shape of a formula for determining the quantity of cooling water necessary to effect the condensation of the steam exhausted into the condenser of an engine. This rule may be found under various modifications, albeit of the same order, in nearly every book or paper which can boast of any connection, however remote, to the subject of steam-power plants. It is found equally in the sixpenny pocket books bearing the oily thumb-prints of the engineer of a one-horse show, to the five-dollar text book over which the student burns the midnight oil. Within the last month it has appeared in the editorial columns of two journals having large circulations among engineers engaged in power-plant work, and yet, strange to say, the truth supposed to underlie it has never been questioned, which can only be accounted for by the fact that the rule overestimates the water required, a proceeding not so serious as an underestimation would be. It might be said that if no harm results from its use, why bother about it? The harm is not so much in its use as in the wrong ideas which it teaches. Few, indeed, have a clear and rational idea of how the heat is distributed in a steam plant, yet it is quite impossible to study its economy without such knowledge.

It has been mentioned that the formula exists in various modifications, but all of much the same form in regard to the essential particulars. One specimen will therefore serve; it is taken from a pocket-book of otherwise unquestionable value:

$$Q = \frac{1114 + (0.3 \times T_S) - T_H}{T_W - t_W}$$

where

Q = pounds of condensing water required per pound of steam used.

T_S = temperature of steam at release.

T_H = temperature of hot well.

t_W and T_W = initial and final temperatures of cooling water.

It may be noted that the expression, $1114 + (0.3 \times T_S)$ is a formula for finding the total heat in one pound of steam of temperature T_S, the heat being reckoned above zero Fahrenheit. It is seen that the principle upon which the rule is based is that the loss of heat by the steam equals the gain in heat by the condensing water, an assumption which is quite correct. The fault of the formula, however, is in the supposition that the loss of heat by the steam, or, in other words, the heat rejected by the engine, which has to be carried away by the circulating water, equals the total heat in the steam at the temperature of release, minus the heat remaining in the condensed water as it flows into the hot well. A more pernicious statement was never taught students; a statement which is not only misleading in itself, but does infinite mischief in assuming as a corollary that the maximum available heat which can be turned into useful work is only that represented by the difference between the total heat in a pound of dry steam at initial pressure and the total heat in a pound of dry steam at release pressure. The assumption that the heat remaining in a pound of steam as it enters the condenser equals the heat in a pound of steam at release pressure, is wholly wrong for two very simple reasons: The *first* because the steam at release is not dry, having something like 20 to 30 per cent. of its weight in the form of water, and consequently possessing only some 70 to 80 per cent. of its heat of vaporization; *secondly*, because heat is abstracted from the steam, in the form of useful work, at a lower temperature than that of release.

Suppose, for example, an engine is working with an initial pressure of 150 pounds gage, = say 165 pounds absolute, a very common pressure for an ordinary compound-condensing engine. Then the total heat supplied to the engine, per pound of steam = 1193.6 heat units, reckoned above 32 degrees Fahr. If the terminal pressure be 10 pounds absolute, then, according to the above formula, the heat rejected is 1140.9 heat units, also reckoned above 32 degrees Fahr. The difference between the heat supplied and the heat rejected must necessarily be the heat utilized, neglecting the small amount lost in radiation in the engine, an amount which, if considered, would make the formula slightly worse. Hence the heat turned into work on the piston per pound of steam = 1193.6 — 1140.9 = 52.7 heat units per pound. Now, one horse-power = 2,545 heat units per hour. Therefore the steam consumption of such an engine must be $\frac{2545}{52.7} = 48.3$ pounds per indicated horse-power hour. Further comment seems needless.

ANALYSIS OF THE PROCESS.

From the above reasoning it is apparent that a method exists from which it is possible to find correctly the quantity of water required for condensing purposes; a method which can, moreover, be applied without requiring any other data than those necessary for the formula usually given for the purpose. For be it noted that the quantity of water, Q, in the rule is per pound of steam used, and therefore to know the total circulating water per hour it is necessary to estimate the probable steam consumption.

Taking the previous example, the heat supplied above 32 degrees Fahr. = 1193.6 heat units; the probable steam consumption is estimated to be, say, 15 pounds per indicated horse-power hour. The heat utilized per pound of steam used is therefore $\frac{2544}{15} = 170$ heat units. Heat rejected, above 32 degrees Fahr. = 1193.6 — 170 = 1023.6 heat units. Temperature of hot well, say 110 degrees Fahr., giving 78 heat units per pound as the heat remaining in the condensed water after leaving the air pumps. Heat rejected to the condenser = 1023.6 — 78 = 945.6 heat units. If the circulating water inlet be 60 degrees and the outlet 95 degrees Fahr., the rise in temperature is 35 degrees, and each pound of water passing thru the condenser carries away 35 heat units, requiring a quantity of cooling water equal to $\frac{945.6}{35} = 27$ pounds per pound of steam. What, may it be asked, could be simpler or clearer than this? Here is a plain, straightforward and, above all, scientific and therefore accurate way of finding the desired answer, in place of an inaccurate rule which no one can understand and which has caused numberless students to fall into the mire from

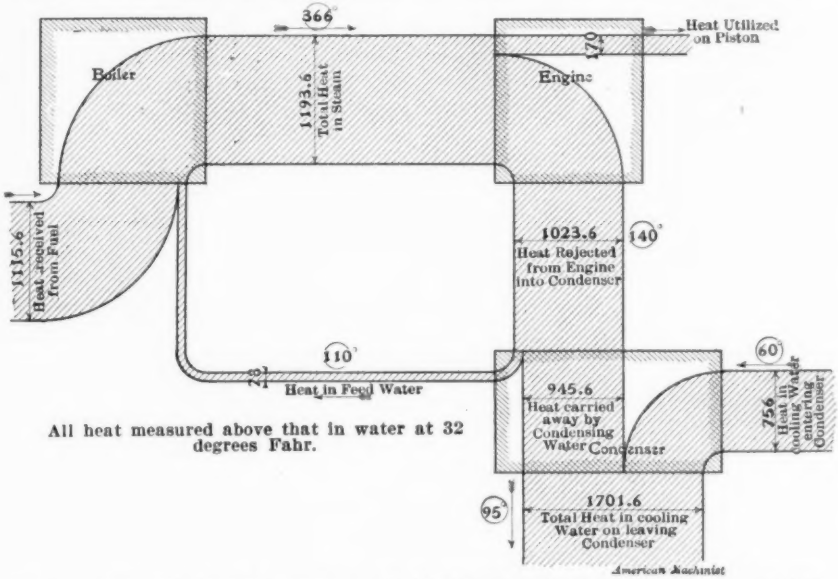


FIG. I. THE FLOW OF HEAT THRU A STEAM ENGINE HAVING NO FEED-WATER HEATER.

which they only emerge to condemn all theory.

THE CORRECT FORMULA.

But, it is argued, the practical man wants a simple formula, even if only empirical, as he cannot reason things out from first principles every time he desires to know how much circulating water he is likely to require. If the practical man cannot reason he is not a practical man; but for the benefit of those who are unable to think, the above reasoning is given in the shape of a formula, but should not be used by others, unless indeed they have a fancy to be spoon fed all their lives.

Let

H = total heat supplied to the engine per pound of steam, reckoned above hot-well temperature;

w = steam consumption of engine in pounds per indicated horse-power hour;

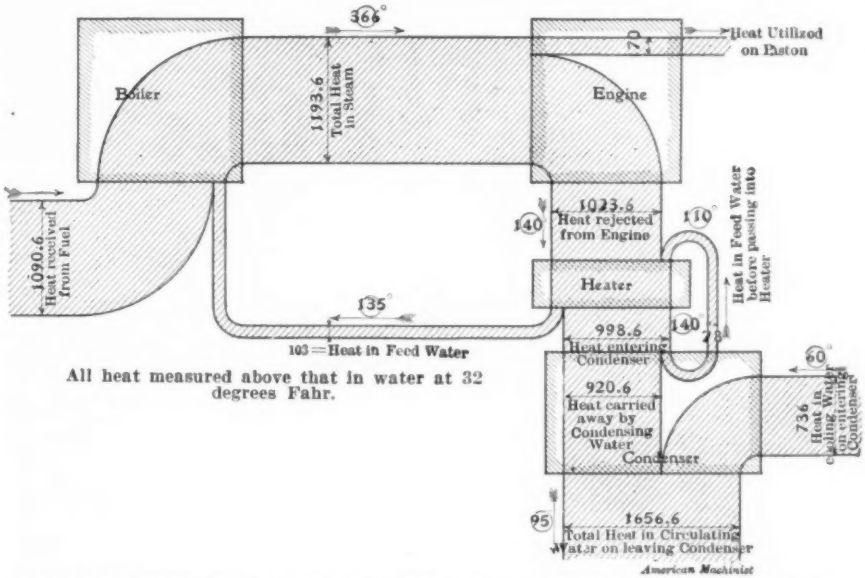


FIG. 2. THE FLOW OF HEAT THRU A STEAM ENGINE HAVING A FEED-WATER HEATER.

T = temperature of cooling water outlet;

t = temperature of cooling water inlet;

W = weight of condensing water required per pound of steam;

then $$W = \frac{H - \frac{2545}{w}}{T - t}$$

GRAPHICAL ILLUSTRATIONS OF THE DISTRIBUTION OF HEAT.

In Fig. 1 is shown graphically and to scale the distribution of heat in a pound of steam passing thru a power plant, consisting of the three essential organs of boiler, engine and condenser. Power for working feed pumps and losses by radiation are neglected, as they do not affect the principle under discussion. Incidentally the smallness of the quantity of heat utilized in doing useful work may be noted, yet the plant is, for its limiting conditions, by no means so uneconomical as are many steam plants in daily use. The diagram also shows how large an amount of low temperature heat passes thru the condenser in the form of cooling water; the quantities given being for one pound of steam condensed.

If the steam supplied to the engine be initially wet, how would the result be affected? Only in so far as the thermal efficiency of the engine would be slightly reduced, owing principally to the increased initial wetness. Thus, suppose the dryness fraction at the steam stop valve be 0.9; then the heat supplied per pound would only be $338 + 855.6 \times 0.9 = 1108$ heat units above 32 Fahr., or 1030 heat units reckoned above hot-well temperature. If there be no loss in efficiency due to the increased wetness, the probable steam consumption would be 16.3 pounds, instead of 15 pounds, but as the efficiency would be slightly less the water per indicated horse-power hour would be correspondingly increased, say to 16.5 pounds, utilizing 154 heat units per pound and rejecting to the condenser $1030 - 154 = 876$ heat units, which, with the same circulating water temperature, would require $\frac{876}{35} = 25$ pounds of water per pound of steam, and $25 \times 16.5 = 412$ pounds of cooling water per indicated horse-power hour, as against $27 \times 15 = 405$ pounds, or an increase of only 1.7 per cent., a difference which can easily be neglected. In most good plants the dryness fraction is never less than about 0.97 to 0.98, which would cause no practical difference in the result obtained.

The danger of expressing such information as this in the shape of a formula lies in the difficulty of meeting all the conditions. If, for instance, a feed water heater of the tubular type be placed between the engine and the condenser, as in Fig. 2, so that the whole of the exhaust steam passes thru it, a quantity of heat is given up to the feed and the heat entering the condenser is correspondingly reduced. As before 1023.6 heat units are rejected from the engine, but the feed is heated from 110 degrees to 135 degrees Fahr., absorbing 25 heat units, leaving $1023.6 - 25 = 998.6$ heat units to enter the condenser. Of this quantity 78 heat units flow into the hot well, leaving a net amount of 920.6 heat units to be taken up by the cooling water. With the same temperatures as before this gives $\frac{920.6}{35} = 26.3$ pounds of cooling water per pound of steam, thus making a slight reduction in the condensing water required.

Extending the Scope of the Case-Hardening Process.

The following specification of a United States patent recently issued to Jean Lecarme, 118 Rue de Vaugirard, Paris, France, should be read with interest and suggests to the man of the shop a new line of experiment with promise of practical results of value:

The process forming the object of the present invention is applicable to articles made of iron, gray iron, or steels not capable of being hardened by tempering. It has for its object to give to these articles new qualities of hardness, tenacity, and others, either throughout their entire mass or only to a certain thickness, and over the entire surface or only over a part thereof, and to render them capable of being tempered. This result is obtained by incorporating with the surface of the metal and to variable depth a body chosen to modify in a convenient way the qualities of the primitive metal. Articles can thus be made in gray iron, iron, or mild steel, which are easy to work, and they can then have given to them over their entire surface or only over determined parts the qualities sought of hardness, tenacity, sonorousness, etc.

The process consists in covering the pieces to be treated or only determined parts of said pieces with a composition containing the body to be incorporated and in heating said pieces to a bright red in a muffle or in boxes filled with wood-charcoal in powder or with sand or in any suitable way excluded from the air. The composition employed for this purpose has for its base a mixture of wood-charcoal in fine powder and a cyanide or ferrocyanide, to which is added an agglutinant material, such as gelatine or dextrine, and the whole is made into a paste, with which the pieces to be treated are coated either entirely or partially.

When it is desired simply to produce on the surface of the article in iron a layer of normal steel—that is to say, when it is desired to cement it—the cyanide or ferrocyanide of potassium is employed, according as it may be desired to have a more or less energetic action.

When it is desired to obtain on the surface of iron a layer of special steel by the incorporation of a metal such as nickel, chromium, manganese, etc., the cyanide of potassium will be replaced by the cyanide of nickel, of chromium, of manga-

nese, etc., or else to the cyanide of potassium will be added a salt or an oxide of the metal which is desired to be incorporated. There can thus be obtained articles having superficially all the qualities of nickel steel, chrome steel, or manganese steel.

Tools made of nickel steel which do not acquire by tempering sufficient hardness may be treated by the process above described with a view to incorporate with them superficially different metals or metalloids suitable for the purpose to which the article is to be applied. Excellent tools are thus economically obtained which never break in tempering. This method applied to the construction of rotary cutters, screw taps, etc., is particularly advantageous.

Finally, compounds can be obtained which are endowed with very various properties by incorporating with them metalloids, such as sulfur, phosphorus, arsenic, nitrogen, etc. These bodies are ordinarily eliminated as much as possible in metallurgy, because they render irons and steels brittle and unsuitable for use in factories; but by incorporating them after manufacture they can give advantageous results in certain operations. These bodies themselves or their acids will be added to the mixture of charcoal and cyanide. The following example is a composition which would be suitable to obtain a layer of steel slightly arsenious: charcoal finely pulverized, ferrocyanide of potassium pulverized, arsenious anhydride (traces), boiled linseed oil, siccative oil of turpentine. This mixture employed in the form of paint gives excellent results—for example, on rotary cutters made of mild steel.

The properties obtained by this process are capable of giving rise to applications entirely new in industry. Thus iron and steel acquire a remarkable sonorousness, the timber or tone of which varies with the body incorporated and the depth of the layer incorporated. Thus bells, clock bells, and other sonorous instruments may be made of iron or steel which may be worked with ease and afterward have given to them the hardness and the tone desired by incorporating with them, as above described, the bodies proper to obtain the result sought.

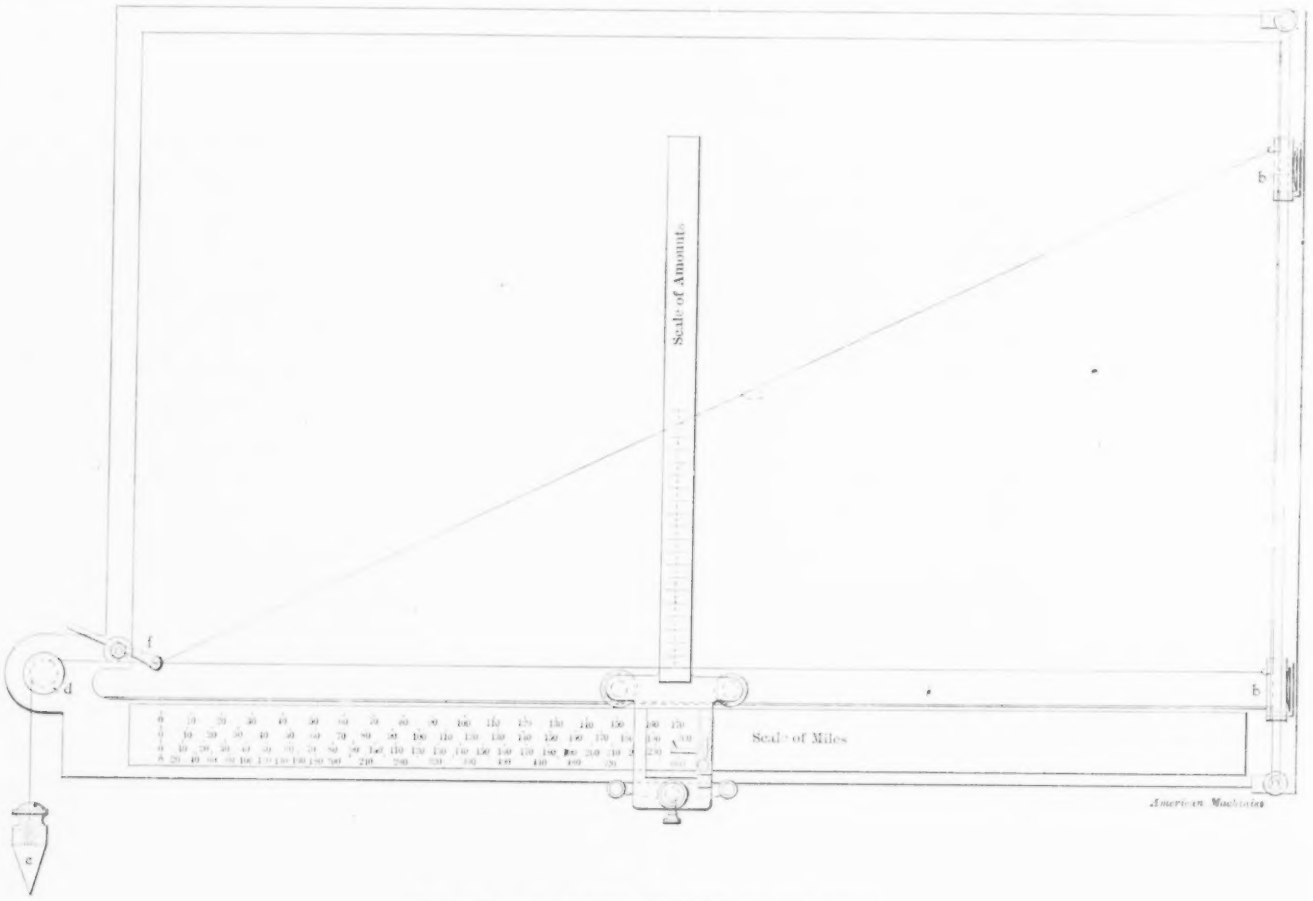
New York city has no rainy season, but it has an exceptionally large rainfall. The atmosphere here has its first wringing out after its mopping of the Atlantic. Last year it was 43 inches, which is about the average, while the average annual rainfall for various cities is as follows: London, 25 inches; Paris, 23 inches; Berlin, 24; St. Petersburg, 17; Rome, 30; Vienna, 20; Dublin, 30; Madrid, 12; Brussels, 29; Naples, 31; Cape Town, 23; Alexandria, 10; Copenhagen, 22; Milwaukee, 30; Pittsburg, 37; Detroit, 30.

A Machine for Solving Problems in Proportion.

BY T. F. OECHSLE.

The machine or instrument shown in the accompanying illustration is intended primarily for railroad or express companies in dividing the amounts charged for transporting packages among several roads in proportion to the mileage over which each road carries them.

The machine is made of a light brass frame about 46 inches long by 30 inches high. Upon the lower edge is a strip of celluloid graduated into several scales of miles. A T-square fitted with friction rollers and a spring is fitted as shown.



MACHINE FOR SOLVING PROBLEMS IN PROPORTION.

The head of the square has a square hole cut thru it and a pointer is so fitted that it may be made to read against any mileage scale desired. The blade of the square is also of celluloid and carries a scale of the amounts to be charged. At the right is a rod *a* carrying a slide *b*, shown in two positions, which supports a wire *c* of 1-1000 inch thickness which runs over a guide pulley *d* at the lower left-hand corner and is kept taut by a 1¼-pound weight *e*.

To use the instrument the T-square is first adjusted to zero of the mileage scale and the wire to the zero of the charge scale by the adjusting piece *f*. The square is then set to the total distance over which the package has been carried and the wire

holder is so set that the wire reads the total amount to be charged, when by placing the square at the mileage over which any road has carried the package the amount due that road is at once read off.

A Chucking Machine Fixture.

BY CHARLES G. RICHARDSON.

Steam levers, exhaust levers, rocker levers, levers big and little, lay in a heap on the second floor and the pile was growing every day. Over in another corner were castings for a lot of double bonnets which were to carry both the admission and the cut-off valve stems. Downstairs they were setting up pumping engines and before long there would be a "holler" for those levers and bonnets. Said holler would be emphasized by the fact that the promised dates of delivery for the engines were fast approaching. If the valves in the cylinders were to travel correctly, if connecting links and rods were to assemble properly, and if the stems in the double bonnets were to be parallel, it was absolutely necessary that the distances between the centers of bearing holes in the parts mentioned should be exactly as prescribed by the drawings.

To the foreman, as he surveyed that pile of castings and thought of the old cut-and-try method of laying out such things, it looked like a big contract. Then he began to wonder if there wasn't some shorter and perhaps better way to meet the proposition. What follows is the result of his meditation.

The essential parts of the fixture decided upon were a sliding block with a vernier attached, the block to carry the levers, etc., to be bored and the vernier to measure on a scale the distance moved from the center of the table of a vertical chucking machine.

As the block was to rest on the top of the table and any little unevenness of the surface would diminish accuracy, the regular table, subject to knocks from tools, wouldn't answer. A secondary table, therefore, was cast from the pattern of a lathe face-plate and carefully machined. At the center of the bottom face was left a projecting hub turned to fit nicely into the hole at the center of the machine table. In the upper face of the secondary table one of the T-slots was planed clear across for a guide for the sliding block. The two tables were clamped together, as shown in the half-tones, and the hole in the center of the upper chucked in place.

FIG. 1. FIXTURE FOR BORING LINKS.

FIG. 2. FIXTURE FOR BORING WORM-GEAR CASE.

Fig. 1 shows the sliding block which was made of gray iron, finished all over, with a tongue on the bottom fitting the T-slot in the table. Near one edge a hole was drilled and counterbored for a clamping bolt to hold the block in position. At the center was put a 1¼-inch reamed hole to receive the upright stud carrying the work. This necessitated providing studs of various diameters at the portion projecting above the block to suit levers of different sizes, but these were easily made of cold-rolled steel, and up to date only about a dozen have been required. The upper parts of the studs were made a sliding fit for the work, while the lower part entered the block by a light drive. The sliding block was flatted on the front side, leaving at the bottom a projecting lip the thickness of a steel scale which had previously been purchased with a vernier for this special purpose. Upon this lip was secured the vernier, reading to thousandths, with the o located exactly opposite the center of the upright stud. The rest of the fixture is nearly self-explanatory. The o of the scale, of course, was fixed in line with the center of the table and therefore the block could be set by direct scale reading to give the required distance, to thousandths of an

inch, between centers of the work in place. In order to insure that the scale would always occupy the same position, two taper pin holes were drilled thru the scale at each end and into the table for a depth of 5/8 inch. The taper pins fitting these were threaded at the top end for round nuts flattened on two sides to take a wrench. A tap or two with the hammer drove in the pins sufficiently to firmly hold the scale and the nuts were then lightly screwed down. Further tightening of the nuts loosened the pins, making the scale easily removable. When the fixture was not in use, the taper pin holes were filled with plugs screwing into a thread at the bottom.

Levers having the same size holes were chucked at one time, of course, and to insure the same amount of stock being removed at each cut, thus promoting accuracy; the tools used in order, as shown, were starting tool, drill, boring tool, .005 inch under size reamer and standard size reamer.

Needless to say, the fixture proved a success; otherwise there would have been no reason for this article. In regard to accuracy, it was found by careful measurement that distances between centers came within an average of .003 inch of perfection, for, as the foreman said, "They couldn't help it." As for the time saved, it caused "the smile that won't come off," the time used being estimated to be from 30 to 40 per cent. less than by the old way.

One day, however, another proposition came up in the form of some small worm gear cases, requiring accurate location of centers in two directions at right angles to each other.

Fig. 2 shows how an addition was made to the fixture to meet these requirements. On the bottom face of an iron angle block on hand was planed a slot to receive a tongue, this in turn fitting a groove in the top of the sliding block. In the upright face of the angle was drilled a hole for a stud exactly in line with the stud hole in the center of the block. This stud, with a nut and washer, held the worm gear case in position, as shown. The photograph also shows how another scale and vernier were utilized, the o of the scale being in line with the inside face of the angle, and the o of the vernier in line with the center of the sliding block. The angle was clamped in position by a tap bolt. It is readily seen that the hole for the worm gear being bored, the long bearing for the worm shaft could be quickly and accurately brought into position for chucking at the required distance between centers and from the face of the case.

The same satisfactory results were obtained with the new arrangement as before. If a new fixture were to be made, more attention would be paid, of course, to the proportions of the parts. Fig. 2, moreover, suggests a design of a universal nature, as the sliding block could be divided into two disks, the upper swiveling upon the lower with graduations and vernier reading in degrees and minutes. The sliding parts might also be moved with fine pitch screws for easily obtaining fine measurements, and no doubt other improvements would suggest themselves, such elaboration depending upon the amount and character of the work in hand.

Labor Conditions in New Jersey Shops.

Students of industrial conditions will find a great quantity of valuable data in the twenty-seventh annual report of the Bureau of Statistics of Labor and Industries of New Jersey for the year ending October 31, 1904. The book is a volume of 617 pages copiously illustrated with half-tones relating to industrial betterment, which forms one of the main features of the report. The first part is occupied with purely statistical matter concerning the leading industries of the State, from which attempt will here be made to glean that which chiefly interests machinery men.

MACHINERY INDUSTRY FIGURES.

A considerable number of well-digested tables have been compiled to set forth and compare the returns of the principal establishments of the State for the year 1903 against 1902. Official publications are usually slow and allowance may be made for the age of this part of the report, which required the assimilation of mature data, the latter portion of the work being brought up to September 30, 1904.

The number of establishments compared for 1903 and 1902 is 1,811, which is believed to cover substantially all the factory industries of the State that have been in operation long enough to be called on for reports. We shall take chiefly the "machinery" class, as it appears in some of the tables, for specific quotation. That does not generally include artisans' tool, electrical appliance, boiler, foundry or forging establishments, and some machinery proper is apparently put elsewhere, but without attempting to define the limits too closely, it may very well answer for comparative, and with greater or less approximation, for quantitative purposes.

The capital invested in 95 machinery establishments in 1903 was $21,715,418, as against $19,611,319 in 1902, showing an increase of 10.7 per cent., which is one of the largest relative and by far the greatest total increase among the more heavily capitalized industries. The textile and chemical are the only manufacturing lines that exceed the machinery in magnitude. The total capital of the State's industries presented by the tables is, for 1903, $339,345,417, showing an increase of 3.7 per cent. over 1902.

The aggregate average number of persons employed in 1903 was for the machinery industry 16,810, an increase of 7.2 per cent. The number employed at period of employment of the smallest number was 16,246, showing an increase of 13.3 per cent. as compared with the time of least number in 1902. The number employed at the period of greatest employment was for 1903, 17,067, an increase of 2.6 against 1902. These figures indicate that in 1903 the steadiness of employment, taking the year as a whole, was much greater than in 1902. Detailed tables, however, giving the number of employees for the several months of the respective years prove that in 1902 there was an almost continuous growth from beginning to end, while in 1903 the minimum was reached at the close. The employees referred to in this paragraph include wage earners, not clerks or salaried persons, but it seems that the classification of weekly pay which follows may be rather more comprehensive as regards office employees.

The average yearly earnings, all industries, was for 1903, $471.81; 1902, $467.13; 1901, $446.66; 1900, $441.19. In the machinery line the average for 1903 was $603.98, against $597.92 for 1902, showing an increase of 1.1 per cent. The aggregate amount paid in wages in the machinery trade was for 1903, $10,152,984, showing an increase of 8.4 per cent. over 1902.

Weekly wages in the machinery industry are thus classified for 1903 in respect to the number of employees receiving them: Under $5, 1,391; $5 but under $6, 584; $6 but under $7, 627; $7 but under $8, 848; $8 but under $9, 1,033; $9 but under $10, 1,736; $10 but under $12, 2,180; $12 but under $15, 3,444; $15 but under $20, 5,199; $20 and over, 1,084.

The average number of days in operation was for the machinery line, 299.62 in 1903, against 301.35 in 1902. The average number of hours worked per day therein was 9.62 for 1903, as compared with 9.73 the preceding year.

The average proportion of business done relative to productive capacity was for machinery, 75.89 per cent. in 1903 against 77.85 per cent. in 1902.

STOCK USED AND OUTPUT.

The following list of different materials used in 1903 by the machinery establishments should be of interest to cost accountants:

Pig iron, 15,992 tons, value $319,477; bar iron and steel, 856 tons, $54,426; scrap iron, 3,344 tons, $64,201; iron castings, 5,036 tons, $316,351; steel castings, 2,017 tons, $161,426; forgings, 462 tons, $37,270; steel and iron, 11,428 tons, $204,015; composition castings, 63 tons, $22,986; steel plates, 4,756 tons, $191,286; steel rails, 1,125 tons, $38,025; tubes, 105 tons, $12,525; copper, 280,466 pounds, $34,555; coal and coke, 4,032 tons, $18,335; lumber, 645,000 feet, $21,990; pig iron, steel, iron, brass, tubes, lumber, etc., $8,340,272; other material, $2,539,018. Total value of material used, $12,376,158.

The output of the machinery establishments in 1903 was as follows:

Locomotives, 411, value $6,286,518; sew-

ing machines and parts, $8,334,312; printing machinery, $814,187; textile machinery, 1,133, $166,505; canning machinery, 370, $88,490; cigar machinery, 4,060, $99,000; electric machinery, 105, $61,590; hatters' machinery, 7,123, $33,815; ice machinery, 6, $10,450; presses (foot and drop), 352, $206,293; elevators, 19, $7,521; Corliss engines, 32, $171,510; Corliss engines (number not given), $210,000; steam engines, 293, $496,580; hoisting engines, 388, $300,420; gas engines, 324, $102,820; engines, boilers and appurtenances, $485,000; turbines, 15,000 horse-power, $300,000; castings, $331,860; machinery (various kinds), $3,558,753; machinery, dies, presses, castings, pulleys, shafting, etc., $4,106,790; other goods made, $1,106,051. Total value of goods made, $27,278,465.

The output of the boiler establishments including tanks, stand pipes, stacks, stokers, etc., and some heaters, was in 1903 $4,743,388. It is to be noted that 187 steam pumps, valued at $147,698, 349 blowers valued at $35,000, and 242 steam condensers valued at $394,921 are classed with "furnaces, ranges and heaters." The overlapping of lines of manufacture among the different establishments no doubt excuses some inconsistency. Some of the valuations seem quite fragmentary.

Passing over transportation and other industries which do not concern us, we come to the

COST OF LIVING IN NEW JERSEY.

Great pains have been taken to ascertain the prices of a large number of provisions in various localities. Surprising differences are shown between the prices in the different places, which the theory of freights is inadequate to explain.

The average cost of a test bill of goods throughout the State is found to be 4.84 per cent. higher in 1904 than in 1898. Ten out of fifty articles included show reductions in price, tho these changes are mostly insignificant. As compared with 1899, the average increase is 12 per cent. On the whole, these statistics do not indicate as great increase in the cost of living as might have been expected.

CASH PAYMENT OF WAGES.

In 1899 the Legislature passed the Stokes Cash Law, which required that all employees except farm laborers and water men should be paid in money at least once in two weeks. This was aimed at the company store abuses in the glass region of South Jersey and the mining district in the north. Sufficient time has elapsed to test the workings of the act. There are now in the State eighteen company stores, the majority of which are in the glass region. Beside the company stores proper in the mining region are some so recognized by the companies as to partake of the same character. In 1899 company store prices averaged nearly 14 per cent. higher than those of private competitors. Now this excess has been reduced to a fraction of a per cent. Instead, however, of the proprietors suffering loss by the changed conditions their gross profits are shown in four out of five illustrative instances to have increased. As an indirect result attributed to the law, the housing of the workmen has greatly improved. In 1899 the proportion of glassworkers owning their homes was less than 10 per cent., while in 1904 it was stated on "reliable authority" that at least 35 per cent. were the owners of their dwellings or would so become after a few more years of payments to building societies. Education is another factor of life that is now on the mend in families of glass workers.

We shall have to pass over the interesting study that is made of social economic conditions prevailing at several different mining centers. In some cases the companies are represented as pursuing an enlightened policy, while in others the practise is less commendable. At one place a mercantile firm said to be closely identified in interest with the mining company is alleged to be restricting housebuilding and thus keeping up rents, by reason of its large realty holdings.

After passing by certain topics, such as the labor legislation of the State and a digest of late court decisions on industrial questions, we arrive at a part of the book speaking of

INDUSTRIAL BETTERMENT INSTITUTIONS IN NEW JERSEY MANUFACTURING ESTABLISHMENTS.

The arrangements made for the welfare of their employees by a considerable number of specific concerns are presented in a very readable manner. Four companies —all of Newark or vicinity—which have made a fine art of providing for the comfort and pleasure of their employees, come in for especial attention. These are the Celluloid Company, the Ferris Brothers' Company, the Sherwin-Williams Company, and the Weston Electrical Instrument Company. The first named has provided for its workers a club house, costing about $40,000, which compares favorably in appearance with some of the fashionable social club buildings of our large cities. The Celluloid Club is here described very elaborately. The Weston Company has also done a vast amount in the way of furnishing club, wash, bath, dining and recreation rooms, etc. A view of the shop lavatory, with its phalanx of individual hand basins, is especially interesting, as is also a picture of an automatic jet drinking fountain, consisting of a basin over which one holds one's mouth to imbibe Adam's ale without recourse to the universal cup. It would be gratifying if our transportation companies and other purveyors of public accommodation would borrow a little philanthropy in this detail.

Mention may now be made of the betterment attempts carried out by other concerns in the machinery or allied lines, but for brevity we must pass lightly over the subject of benefit associations with which the reports are largely concerned.

The American Brake-Shoe & Foundry Company, Mahwah, provides a lunch and bath room, contributes to a hospital for a bed and facilitates the acquirement of stock by worthy employees.

The American Engine Company, Bound Brook, has hitherto been unable to do as much as it would like, but has adopted a premium plan.

The American Swiss File & Tool Company, Elizabeth, has a limited form of profit-sharing, encourages its employees to become members of building and loan associations, contributes liberally to local hospitals and otherwise looks after its men. It would like to adopt profit-sharing more generally if a satisfactory plan could be devised.

The Ayers Machine Company, Salem, provides washroom with hot and cold water, lockers, etc.

William C. Baker, Hoboken, car heaters, tho as yet too small a concern for luxuries, allows a week's vacation with full pay, beside paying in full for six public holidays.

The Crescent Shipyard Company employees, Elizabethport, contribute ten cents a month each to hospitals and receive free treatment.

The Crocker-Wheeler Company, Ampere, was, at the time of report, contemplating the establishment of a benefit organization. It furnishes light and well-ventilated work rooms, modern toilet rooms, iron screen lockers, lawns, gardens, etc., surrounding factory, various hospital and emergency facilities, etc.

The DeWitt Wire Cloth Company, Belleville, has a profit-sharing plan which is working satisfactorily.

The Driver-Harris Wire Company, Harrison, tried one but gave it up on account of a strike.

The W. D. Forbes Company, Hoboken, acting together with its employees, carries on a mutual insurance fund. It has a 54-hour week, closing Saturday at 11 o'clock.

The Gibson Iron Works, Jersey City, takes out policies insuring the lives of employees of five years' standing for $1,000 to $2,000, paying the premiums while they remain in its employ. It has also presented stock to worthy employees and gives 50 to 100 neighborhood children an outing on Decoration and Labor days.

Gould & Eberhardt, Newark, have no special betterment feature except a mutual benefit association owned and controlled by the workmen and with which the company has nothing to do except in an advisory capacity. In its letter on the betterment subject it says: "We do not believe that it helps the man to give him something for nothing, nor do we believe that he wants it. We have seen, in a great many instances throughout the country where various plans of this kind have been tried, that the men rather resent it and come to look upon it as a charity which is not desired. We believe in giving a man a chance to earn his recrea-

tions, rather than provide them for him gratis, and we feel that all plans worked out on a basis of giving the man something for nothing are bound to fail, for the very reason that it can be nothing other than more or less of a charitable distribution, and that the American workman is above anything of this nature."

The C. Howard Hunt Pen Company, Camden, has a method of stock-sharing with its leading men, and gives every operative who is in regular attendance to his duties every day of the month one day vacation with pay. The hours of labor have been reduced from ten to eight, certain dangerous machinery has been replaced by modern types and other reforms and projects are in view.

The employees of the Ingersoll-Sergeant Drill Company, Phillipsburg, acting in conjunction with the company, have established a well-working benefit association.

The empoyees of Keuffel & Esser, Hoboken, have a sick-benefit society. They participate with the members of the firm and their families in a picnic in the summer and some social affair in the winter.

L. O. Koven & Bros., Jersey City, range boilers, are careful as to the light and sanitary condition of their works, and contribute to hospitals, Y. M. C. A. and Boys' Club.

The Ludlam Steel & Spring Company, Pompton, provides a reading-room, for which 5 cents monthly dues are charged, subscribes to a hospital, encourages athletics and has provided a baseball field; but, above all, its location affords its employees the advantages of attractive rural surroundings and pastimes.

The employees of the Marine Engine & Machine Company, Harrison, have a mutual benefit association.

The Samuel L. Moore & Sons Company, Elizabeth, has an arrangement with a hospital to treat its employees when injured in the actual performance of duty, each contributing 10 cents per month for this privilege.

The employees of the National Saw Company, Newark, have organized an insurance system.

The management of the New York Switch & Crossing Co., Hoboken, stands ready to pay the expenses of a correspondence school course for any employee. It subscribes for a full line of industrial and mechanical publications relating to its line of business, and distributes same to all employees who desire to read them. It also makes liberal hospital contributions.

Among many progressive features at the works of the Patton Paint Company, Newark, are the office and factory councils, by which the heads of departments and workmen, respectively, co-operate with the management. Some others are a free supply of freshly laundered overalls every day, lunch rooms, recreation, a library and a literary society.

The employees of the Perth Amboy Dry Dock Company, with the firm's co-operation, have organized an accident benefit association.

The Reeves Engine Company, Trenton, has introduced high-grade sanitary arrangements. Its motto is, "Big wages, healthy conditions to work under, and big production." The premium plan is followed. The company belongs to the Manufacturers' and Employers' Association of Trenton, N. J., whose objects are, in part, defensive and arbitrative, and which maintains a bureau not only for labor employment, but to investigate confidential reports by the workmen of unfair treatment, with a view to correction.

The employees of the Ulster Iron Works, Dover, have organized a benefit association.

The workmen of the Victor Talking Machine Company, Camden, have a sick benefit association, organized and managed by themselves and initially assisted financially by the company.

The R. D. Wood Company, iron founder, gray-iron pipe and valve-maker, etc., Millville, Camden and Florence, makes a policy of indicating to the workmen the lines to be followed to advance their own interests rather than of doing things for them. It seems to be doing considerable, since, according to its statement, it maintains a store where they may buy without compulsion, at prices as near as possible to cost, rents houses at moderate rates, conducts what is practically a savings bank, and furnishes a lodge hall, with cooking school, sewing lessons, etc. The company has aimed to keep its works going steadily thru bad as well as good times, so that for the desirable and serious men there should be as nearly continuous employment as possible.

Of the remainder of the book, which comprises an industrial chronology for the twelve months ending Sept. 30, 1904, we have no occasion to speak further than to refer to the table of accidents to workmen on duty. This shows that in a total of 224 injured there were 23 iron and steel founders and 22 machinists; in a total of 25 killed was one founder and one machinist.

A Novel Method of Cutting an Internal Gear.

BY E. H. FISH.

When the problem arose of cutting a 99-tooth 3-pitch internal gear for a lathe face plate with nothing apparently available but a plain spur gear cutter, and no internal gear cutting attachment purchasable, we had to do some hurried thinking, the results of which are shown in Figs. 1 and 2.

We redesigned the face plate so that the gear itself *a*, Fig. 1, was an annular ring which fitted snugly into the face plate and was held by a number of dowel pins *b* driven into holes drilled into the spaces between the teeth. These pins can be driven clear thru if we ever need to get the gear out for repairs. We then rigged up a cross-shaped frame of hardwood and bolted it to a face plate which had a center shaft fitted to the gear cutter spindle, and laid the ring on these arms, trued it up and strapped it down lightly, so that we could nick the outside with ninety-nine grooves. These grooves were intended to make the ring its own index plate, and were milled on the side of the outer surface which was concealed from sight when the ring was driven home, as shown at *c*, Fig. 1. These nicks were made with a cutter whose sides inclined toward each other at about 15 degrees.

The nicked ring was then transferred to a planer and set up in the flat crotch *d*,

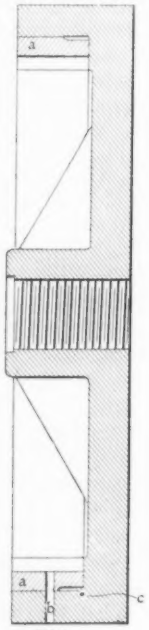


FIG. 1

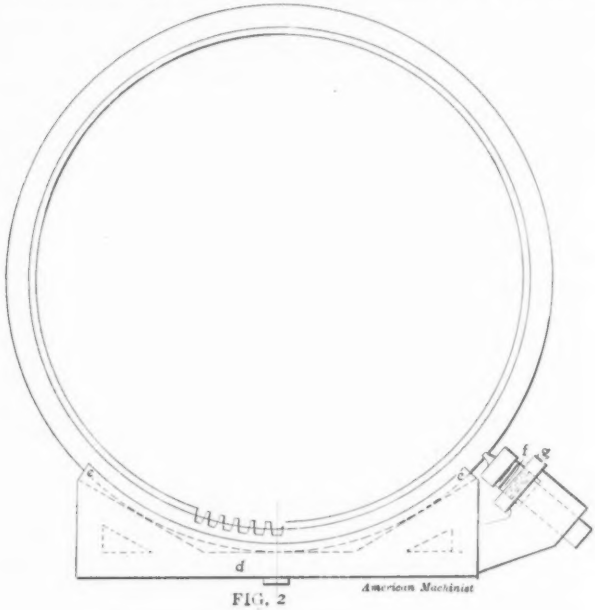


FIG. 2

CUTTING AN INTERNAL GEAR ON A PLANER.

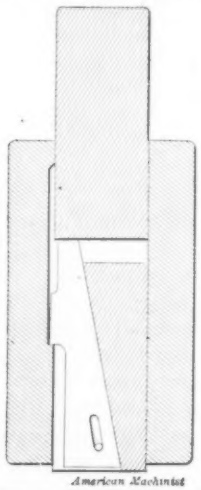
Fig. 2, which was clamped to the table. The ring was held in place by two machinist's clamps, put on at *e e* and strapped down by ordinary planer straps straddling the space to be cut out. The screw at *f*, with the wedge-shaped head, was set up by the nurled nut *g* until it held the ring securely without lifting it from the holder. The stem of the screw was a nice fit in the bracket, and no trouble was experienced in getting a good even indexing.

We expected at first that we would have trouble in turning the ring in the crotch, but we had none that was noticeable. The cutting was done with a square-nosed roughing tool, which was run down almost full depth and was followed by a formed tool made for us by the Brown & Sharpe Manufacturing Company, and which could be ground without changing its shape. We cut down in both cases to a positive stop on the planer head, using the power feed till we were almost down and finishing by hand.

The resulting gears made a very good job under the slow speeds at which they were intended to run, and gave a very smooth cutting action to the lathes they were used on.

Oil Groove Cutting Tool.

We illustrate a very neat and obviously useful tool for cutting oil grooves in bearings which is in large use at the works of the Garvin Machine Company, of this city. The cutting tool slides in a recess having an inclined bottom, whereby it may be withdrawn within the shank and entered



OIL GROOVE CUTTING TOOL AT WORK.

in the bearing in which the groove is to be cut. The pressure of the finger upon its end then causes it to bite the bored surface sufficiently to start the cut and pressure upon the end of the shank quickly completes the groove. The engraving shows the tool in section within a bearing with the groove partly cut. In use the cutting pressure is, for light pieces, obtained by a mandrel press. For heavier work a soft hammer is used. The groove made will be seen to be blind at the ends, the result being a first-class job at a trifling cost.

Letters to the Editor.

A Young Boss Who Was Not Straw.

The wail of Strawboss at page 390 is certainly interesting, and to me, at least, somewhat amusing. It is indeed a sad state of affairs that he describes. It may be that it is not hopeless, but much depends on the patient himself. It seems that there is a very decided lack of nerve, and nothing short of despair is likely to hold the patient up to the heroic treatment necessary for recovery under his present conditions of servitude.

As I have spent more than a quarter of a century in machine shops in one place and another, I have come into contact with a number of bosses of different kinds. Some were of high and some were of low degree. Some were of straw and some were very much the reverse, and the straw bosses were not all of low degree, either, by any means.

George was a workman who was put in charge of a night gang during a temporary rush. He was young and bashful, but was quite a hand to hang on to whatever he was put at and to worry it thru to a conclusion somehow.

In the gang were some of the men who had been working with him days, and in addition to these he was given everything that came along and that claimed to be a machinist. Some of these latter were about as tough specimens as could be found anywhere.

Among the old hands was one young man who had asked for night work. He had worked near George, and they had been very good friends, and George was pleased to find him among those who would be on the night turn. Frank had evidently figured it out that it would be a "soft snap," as the boys express it, to work nights, and started right in the first thing having a good time. George was so busy for a few nights trying to get his raw recruits into working shape that he did not notice it much, or if he did he might have thought that it would wear off; but finally, one night he had a leisure spell, and after Frank had been singing and whistling and calling across the shop for some time, he walked up. "See here, now, Frank, don't you think it is time to drop it and get down to business?" he asked.

"What do you mean?" replied Frank, with a show of indignation. "I am working harder than ever I worked before, and I don't want any slave driver coming around, either."

"Come, come now, Frank," said George, laughing. "There is no use of you talking that way. We are both here to do honest work, and I think we both intend to do it; but I have to keep order among a lot of men, many of whom are new to the shop. If I let you make the kind of a racket you have been making for a while back, I could never hold the rest of them in."

"If you don't like me, why don't you hunt up some excuse to report me to the superintendent in the morning. These little tin gods have to have some way of showing their authority. It beats the dickens how some fellows swell up as soon as they get a little chance. You can't run on me, d—— you, and you may just as well know it right now." Frank's temper and his voice had both been rising, and the last of his talk had been fairly shouted, and had attracted the attention of quite a number of the men.

George stood still a minute, and then his mind was made up. He had not been given any very definite authority when he was told to "look after" that night gang; but it seemed to him that there was some that he must have or else he could not run the gang. "If you do not care to work for me just as quietly and orderly as you have been in the habit of doing days, you will not work nights while I am in charge."

"Hear him, will you? Who in h—— gave you any right to say whether I should work or not? I never asked you for a job, and if you go and tell a pack of lies on me and get me discharged I will hammer the life out of you, you——"

George looked at his watch. "Your time stops now," and reached and shut down the machine as he spoke. "You don't do any more work with me. If the superintendent cares to put you on days again, that is his business." With that George walked away. All his talking had been done in a low tone, which did not reach many of the men, but they could see his action in stopping the machine.

Frank looked after him, reached up and took hold of the shipper, stood looking up thru the shop for a few minutes, and then very slowly began to take off his overclothes. Evidently the sober second thought was coming. He had a wife and baby, and threshing the boss would not feed them or help him to get another job. He didn't like to work nights if he had to work just as the day gang did, but——. It took him a long time to find his tools, and finally he walked up to George with: "I don't know as you have any right to fire me, but I suppose if you have your mind made up to do it I might as well go now as any time."

"You seem to have some doubts as to my authority. If you will work quietly as you should till morning, go back to work. In the morning go to the superintendent and find out how much authority I have and I will see you to-morrow evening before time to go to work."

Frank thought it best to return to work, and was orderly the rest of the night. The next night he came up to George and asked if he could go to work. George had not seen the superintendent and did not know whether Frank had or not, but he had made up his mind he was going to run things as long as he was in charge.

"If you are willing to work for me you may." Frank went to work. After a while the superintendent came in. Evidently someone had told him something about the trouble. He looked over the work and inquired about the men and one thing and another, but George did not mention it. Finally he said: "I heard that Frank was doing some loud talking last night. What was getting into him?"

"Nothing very much," answered George. "He got a little gay and noisy, and when I tried to tone him down a bit he seemed to think I was without any authority here. I guess he thought I was just put here for ornament. I think I got that idea out of his head, and he will be all right now. I am here to do what work you give me orders to do and every man who is working here nights may as well know now as any other time that as far as they are concerned I am the one to give them orders. I expect to be held responsible for results, and when someone else reaches over my head to the men there will be room at once for another night boss."

George did not mean this as bombast. He had thought the matter over as he was used to thinking his different jobs over and here was a condition which he considered absolutely essential to filling the position, and he had made up his mind that he could not do it in any other way. He would not try to do a job of machine work without facilities, and this and some other things were facilities for doing a good job of bossing.

Several times George went to the superintendent and had a quiet talk when he thought his authority was not being sufficiently recognized by the company and asked to have little matters changed. He explained why he did so, and there was never any trouble about it. As to his popularity with the men, I know that they worked with such good will that they turned out as much work, hour for hour, as the day gang did, and that without driving, and Frank was one of the best men in the lot.

This shop had started in as a custom shop. It now had a regular line of work, but still did all the jobs that came along. Verbal orders were the rule, and George found that they were a source of trouble, and he made it his practise to either give a man a sample to work to, or if it was a piece of repair work he wrote the sizes down and then looked to the man to work to them. This worked all right as far as it went, but it did not help the trouble that came from work that lapped over from the day to the night turn. Here he found his men were getting orders from all sources. The man who ran the machine days would give all sorts of orders to the man who ran it nights, and do it on the stated authority of the superintendent.

The men in the erecting room would leave word for such and such work to be ready for morning, and often George thought some of the men imagined that they had received an order from somewhere when there was an easy job at hand which they wished to do. Too many bosses spoil work just as surely as too many cooks spoil the broth, and one evening George had a talk about it with the superintendent.

"I know there have been several mix-ups, but I did not particularly blame you for them," said the superintendent. "It will be all right as soon as the new men get a little more used to the shop."

"It is a little hard for me to mind all the details, and I don't want to feel as tho the men were working me. Would you mind marking what you want done on paper and leaving it where I can get it. That would put it where I would not have any excuse for forgetting any job you wanted done." Several jobs had been neglected because George had forgotten all about them and that perhaps made the superintendent a little bit more favorable to the idea than he otherwise might have been. A hook was provided in the office. (George personally saw to getting the hook and putting it up. He also called the attention of the entire office force to it, and explained its purpose.)

A few nights after the hook was put up he asked the superintendent if he didn't think it was a good idea to have the erecting gang boss put a slip on the hook if he was in need of anything, and if there were any complaints about the night work he would be sure to get them if they were put on the hook. The superintendent saw that the hook was going to be a good thing to lighten his own work and sided in with everything that was suggested. The men soon found that George was the only one who gave them orders, and the men on the day gang found out that the only way they could get anything was thru that hook, and they used it on all proper occasions.

The system did not work itself. George would get around early enough in the evenings frequently to see the superintendent and the men on the day gang who had charge of work to see if they had a slip on the hook for everything they wanted for the night, and occasionally he would let some job that should have been done stand because the notice about it had not come.

To even things up, some of the men used to take delight in finding fault with the work, and some evenings there would be a lot of slips with all sorts of kicks on them. From some of them it would seem that the only men about the place who could do poor work were on the night gang, and after he found that some of the work complained of had never been done by the night men he quietly had his men mark their work. He investigated every kick along with the man who was doing the work. If the work had been done at night they planned to do it better, and if it had not been done at night the man was given to feel that he would be cleared of all blame. He was also encouraged to try to do better work than the other fellow. When the men who kicked found that they had to show reasonable grounds for every kick the unreasonable ones got to be scarce.

There is no use denying that there were some men who said hard things about George and the way he did things, and there were those who were glad to let him know that such was the case; but George knew that every boss is talked about by some of the men, and he did not let that bother him. He had heard that sort of talk ever since he had been in a machine shop. He knew that the office would put up with lots of his ways if he got out the work, and he made a shrewd guess that he would not last long, no matter how nice his ways, if he didn't get it out.

If Strawboss really wants to change his atmosphere he will have to persistently work at it, using thought, care, judgment, tact and patience, just the same as he would do with a difficult job of machine work. It is not the kind of a job that he can "bull" thru, neither is it the kind of a job that will stay worked without attention after things are once in the right channel.

If Strawboss feels that a boss of any kind is different flesh and blood from others, and for that reason should be treated with deference, he would better not disturb the present arrangements; but if he only wants the authority that is necessary to do the things that he is responsible for, he should certainly be able to get it in time, even after letting things go as he seems to have done.

Don't "swell up," and don't get in a hurry. "There is luck in leisure."

WILBER.

Crystallization and Fatigue of Metals.

"Crystallization Experience," at page 553, is right in line with what has been learned in using chains for cranes. The best wrought-iron chain, after being used a while, will become exceedingly brittle and break without warning or showing any evidence of its condition. The length of time it takes to reach this condition depends upon the amount and severity of service it gets, and the remedy is to anneal it carefully. The hooks, if forged from wrought iron, also are improved by annealing. A great many of the apparently inexplicable crane accidents are due to this fatigue of wrought iron when in continual use. The length of time between annealings depends to a certain extent upon the service, but it is not advisable to allow more than a year between the treatments, and four to six months is better if the work is severe. At the time of annealing the chain should be very carefully gone over and all defective links should be cut out and replaced. In annealing chain it should be heated slowly

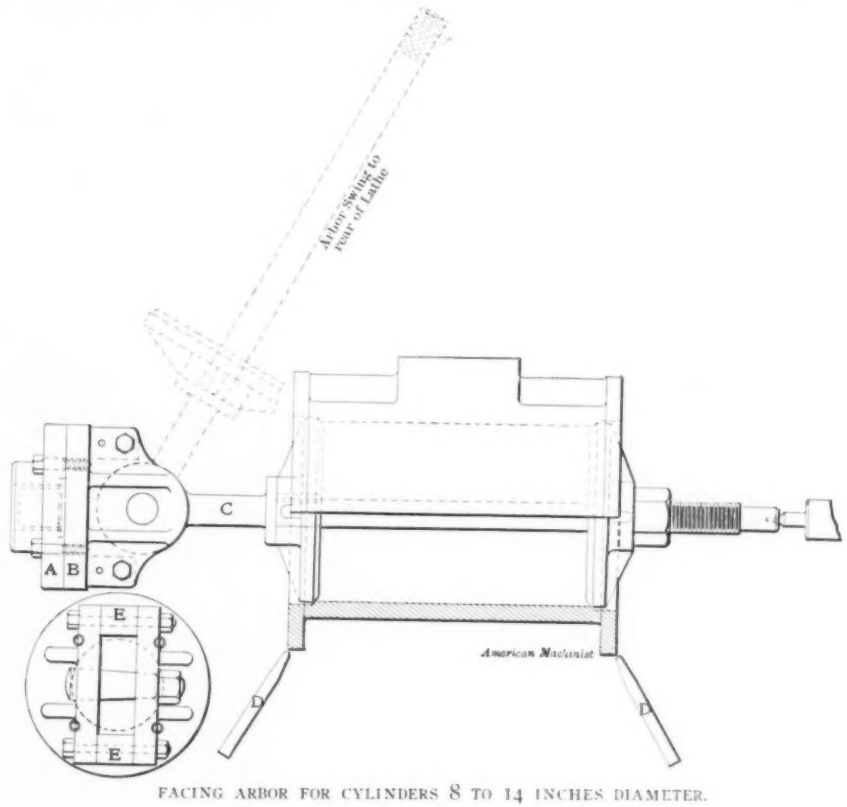
and carefully, to avoid burning it, to a good red heat and cooled slowly. Very few cranes are built to-day with chain hoists, wire rope being used because it is safer and less likely to fail without warning; it is also cheaper.

A. D. WILLIAMS.

A Handy Arbor for Cylinders.

The ordinary arbor such as we had in use for facing the steam and pump cylinder flanges did the work, but we could not get the quantity desired, so we produced the special cylinder flange facing arbor shown. We found a good increase in the amount of work produced.

A is the lathe carrier plate, made sufficiently large and strong. *B* is a gray-iron casting fastened to *A* by means of four 1-inch cap bolts, and having two walls or standards to carry swivel end of arbor *C*. The opening between the walls of *B* was machined entirely thru and distance pieces *E E* placed at outer edges of walls and bolted and doweled, as shown. The two walls are reinforced by ribs extending well forward, as shown. A 2-inch taper pin connects the walls of *B* and the arbor *C*, held in by a draw nut against the outer side of the wall. The swivel



FACING ARBOR FOR CYLINDERS 8 TO 14 INCHES DIAMETER.

end of the arbor *C* is 8 inches in diameter, while the arbor proper is 2½ inches in diameter. The sketch shows a 14x14-inch steam cylinder on the arbor ready to be faced and turned. *D D* are tools, and each tool has its separate carriage, so that the facing of both ends of the cylinder is going on at the same time.

A collar is forged and finished upon the arbor *C* near the swivel end, against which the cylinder centering head is forced; this head being also keyed to the arbor makes it positive. The other centering head is forced against the cylinder counterbore by means of the nut and screw on the arbor *C*. When wishing to remove work from the lathe, we bring the flat of the swivel end parallel to the lathe shears, and "lock" the lathe by cone pulley and cone gear, and back gear. A sling now connects the crane to the cylinder, and on running back the tail center the work and arbor are swung back of the lathe, when the cylinder can be readily removed and replaced by another, and all is swung back into the lathe while the work is still hanging in the crane.

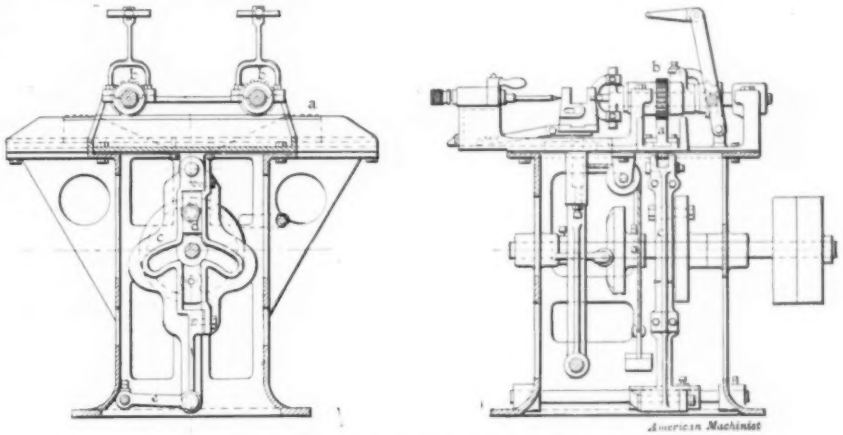
The centering head and nut can now be manipulated as desired. The arrangement gives excellent satisfaction.

BECK.

An Unsuccessful Mechanical Movement.

An attempt to design a machine in which a certain rack must have a reciprocating motion across the bed, is shown in the accompanying illustration for the purpose of pointing out how easy it is to be deceived by what looks like a good idea.

This machine had a cabinet base, with journals at the front and rear for the driving shaft, having on it at the back side the usual tight and loose pulleys,



AN INGENIOUS DEVICE THAT FAILED.

while inside the base, near the front end, was a cam for moving certain work carrying parts back and forth relatively to the reciprocations of the rack *a*, which meshed with spindle-driving gears *b b* in the heads of the machine and imparted to them an oscillating motion. The desired action of the rack was thought to have been neatly provided for by the trammel connection *c*, which obviated cutting the shaft and took the place of a crank.

In a disk secured to the shaft was set a pin, having a sliding block *d* thereon fitted to the vertical slot in the trammel, which was pivotally connected at its upper end to a bracket secured on the bottom of the rack. At the lower end of the trammel was a link connection *e*, from the base, which served to keep the lower pivotal center in an approximately vertical plane and which would allow the trammel to raise as it moved in either direction from its central position, which it must do because its upper end traveled in a horizontal plane. Clearance recesses for the shaft were cored on each side of the block slideway, in which provisions were made to take up wear. Evidently this device would give an equal amount of motion on each side of its center line, and while it was apparent that the motion would not be alike in speed in both directions this was not thought to be of serious consequence.

When this machine was set up for testing it developed the fact that, while the reversal of rack travel and consequent rotation of spindles was accomplished as smoothly as could be desired at one end, that at the other such shock and jar took

place as threatened to disrupt the machine. Recourse was had to counterbalancing the shaft, but to no effect whatever; in fact, it may be noticed that the trammel and not the shaft was the proper subject for counterbalancing, and it may also be noticed that there was no opportunity to add a balance to it.

An examination of the trammel, disk and pin, in the light of this experience, showed that the pin in the disk, when at a point directly above the center, was at a certain distance from the pivotal point of the trammel, and when under the shaft that it was very much closer to the same pivotal point of the trammel. The distances between the upper and lower pin positions and the pivotal point being approximately in the proportion of two to one, necessarily the relative ratio of motion to the right and left respectively would be the same, whence came the great difference in action at the ends of the stroke.

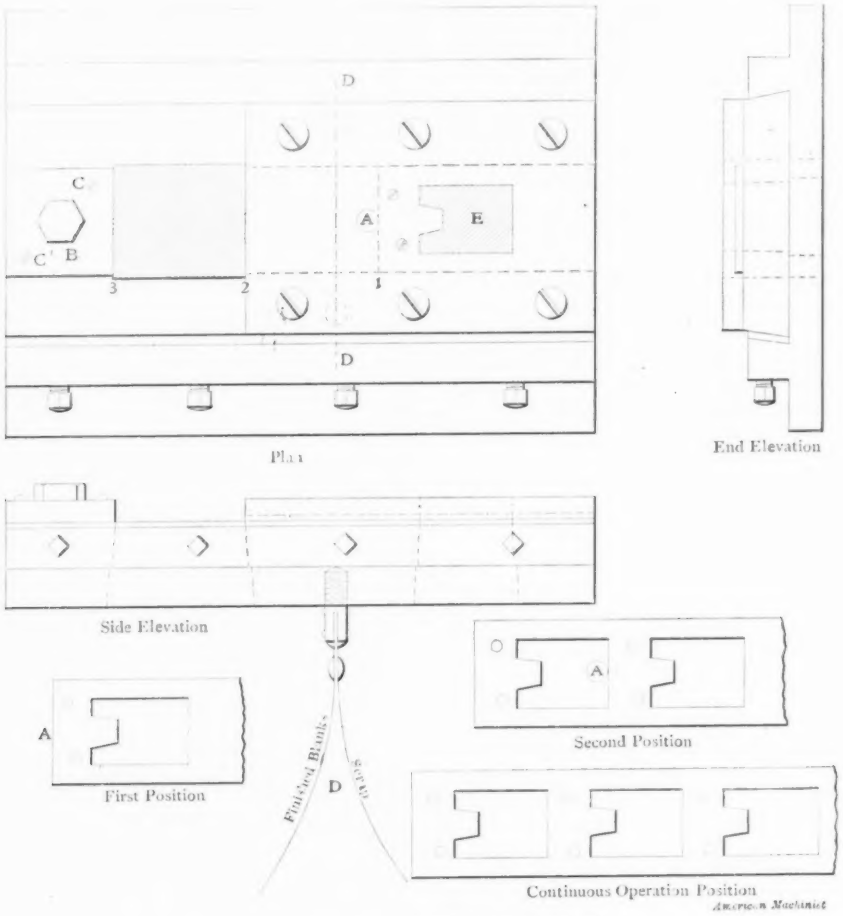
The jar or shock at the point of reversal having been caused by the accelerated speed of the trammel and its abnormally acquired momentum, it was thought to overcome this by a stiff spring, allowing it to exert a constantly increasing tension from the start of the rapid stroke. This was found to absorb the shock so satisfactorily that little appreciable difference could be detected, but it called for an increase of belt power and an uneven exertion thereof.

Finally the trammel was discarded and another method of driving substituted.

WARREN E. WILLIS.

Another Way of Cutting Circuit Breaker Clips.

Referring to the letter at page 502 about "Cutting circuit breaker clips," I enclose sketches illustrating what I believe to be a better way of doing the same thing. At least very satisfactory personal experience leads me to believe that the method here described will prove more economical, both in labor and material, than the methods shown in your previous article.



CUTTING CIRCUIT-BREAKER CLIPS.

Referring to the plan view, the shaded portions are sections of the punches in corresponding holes in the die. *A* is a removable or temporary stop pin. *B* is a solid block stop with dowel pins *C* and *C*¹. *D* is a separator under the die, keeping the scrap and the blanks apart and directing them to their respective chutes. The die is shown held in the shoe ready for the press. The scrap separator *D* is placed in the hollow recess in the bed of the press. The die is fitted with a stripper extending from the right-hand end to position 2, and the stop *A* is provided with a suitable handle extending out to one side sufficiently to permit the operator to handle it conveniently.

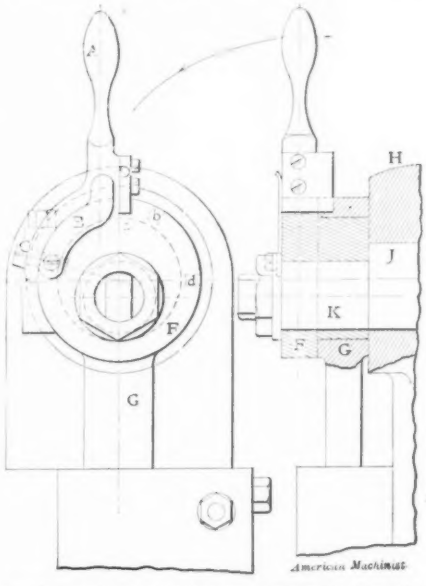
The operation is as follows: The stock is inserted in the stripper as far as line 1 against the stop *A* and the press is operated, stamping out the shaded scrap *E*. The stop pin *A* is withdrawn and the stock is advanced a little farther, the stop pin *A* being reinserted and the stock held against it, as shown in the second position. The press is again operated. The stop pin *A* is then permanently removed and the stock is advanced to touch the solid stop *B*, when the press is again operated, forming the blank shown in the second position. The stop pin *A* is not required again until beginning to punch another strip. The operation of the press can be continuous, the feeding of the stock taking place either by hand pressure or by friction roll feed, the actual feeding taking place between strokes.

In this method of operating there is no unnecessary scrap, the operation is continuous, except when changing from one strip to another, and the scrap and blanks are kept separate and out of the way, avoiding the necessity for removing the blanks between operations.

J. M. FULLMAN.

Quick Hight Adjustment of Power Press.

Many a manufacturer has doubtless discovered ere this what a handy and efficient riveting machine is a power punch press on certain kinds of work. The sketch shows a device for readily adjusting the plunger hight to rivets of



QUICK HIGHT ADJUSTMENT OF POWER PRESS FOR RIVETING.

different lengths when the pieces to be riveted are of different thicknesses. Here is the head of an ordinary power press, in which *J* is the shaft carrying the eccentric pin *K* which actuates the connection *G*, which is bored to fit the eccentric ring *F*, which in turn is fitted internally to *K*.

A is a lever working on the fulcrum screw *C*, carrying a steel plate *D*, which

works in a slot in *F* and also fits the slots *a*, *b*, *c* and *d* in the ring of the connection *G*. *A* is held back in place by the flat spring *B*. By pulling the lever forward in the direction of the arrow the plunger *K* is released from the eccentric ring *F*. By moving the lever into the slots *f*, *c* or *d* the plunger is lowered, the slots of course being arranged to get the variation to correspond with the different thicknesses operated upon. S. BLISS.

A Blueprint Outfit.

Inasmuch as the following arrangement of a room for blueprinting is in use every day, giving perfect satisfaction, it will no doubt interest those who have much of this kind of work to do.

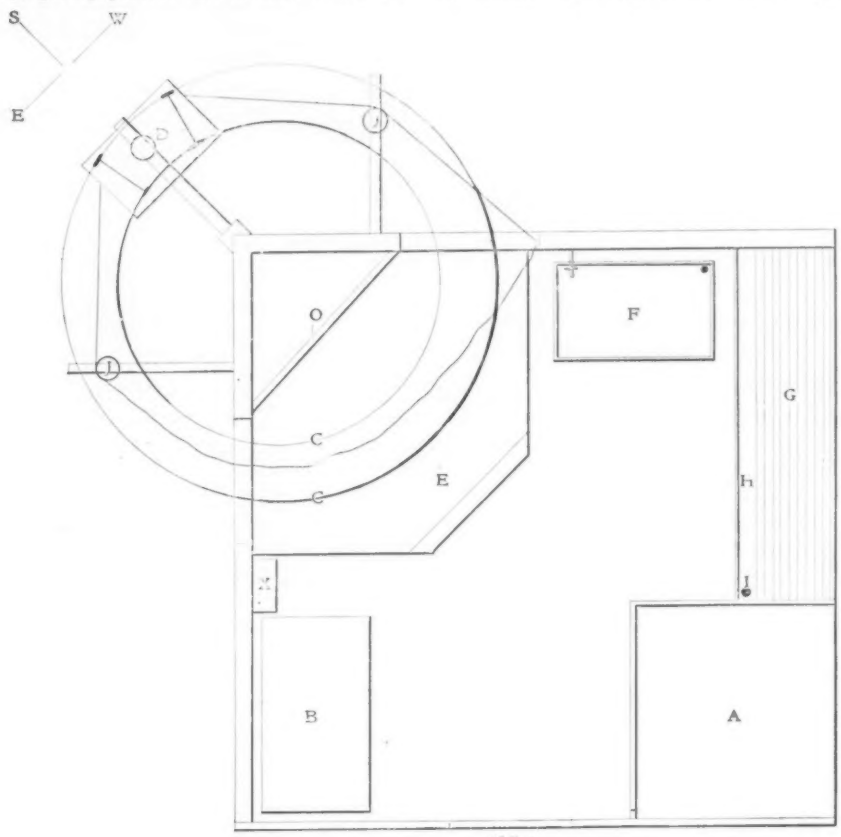


FIG. 1

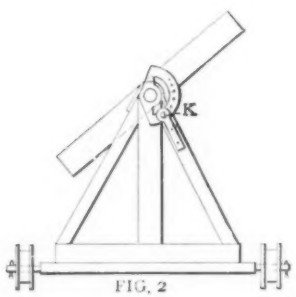


FIG. 2

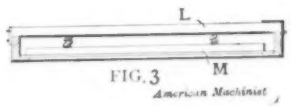


FIG. 3

American Machinist

A BLUEPRINT OUTFIT.

In Fig. 1 *A* is the dark room, *B* the table for cutting and trimming, *X* the paper box in which the cut paper is kept, *C* the track for carrying truck, *D* and *E* the platform for the printer. *F* is the washing tank and *G* the drying lines under which is drip pan *H* with outlet *I*. The track is circular, made of ½x2-inch wrought iron, and supported by three brackets attached to the wall, as shown. The axles are bolted solid to the truck, being given the proper angle for the curve of the track. The double flanged wheels have end play to allow for irregularities in the curve. Deeply grooved wheels *J* revolve on each of the brackets and act as guides for a rope attached to each end of the truck.

The frame swings as shown in Fig. 2 and is positively locked at the required angle by a lock pin *K* engaging holes in the circular bracket attached to the printing frame. The rope is intended to pull the frame both in and out, regulating the position of the truck from inside the room. This, however, the blueprinter changed, using a rope attached to a hook on the truck which he secures to either end, as required. This rope is used to pull the frame inward only, relying on a push to send it out, the operator preferring to run it too far and pull back in position rather than use the rope for both directions.

A cross-section of the frame is shown in Fig. 3. The cross-bars *L* are hinged to the frame and are secured at the other end by a hook on the frame. Spiral springs are secured to each bar (of which there are three) and to the board *M*. Board *M* is in three sections to equalize the pressure, and is held together with heavy felt cloth pasted on under side, making it practically one piece hinged to the frame. It is thrown back against bar *O*, Fig. 1, when removing the prints.

The corner of the building, in this instance, points directly south. At any time of the day, winter or summer, the frame can be adjusted so that the sun's rays fall perpendicularly on its face. This makes a perfectly universal frame with only one swivel, the other angle being acquired by the curve of the track. L. F. B.

Templets for Armature Segment Dies.

Armature die making is a subject of interest to a large number of toolmakers. In a recent article at page 498 on making a die without a templet Toolmaker says as good work can be done without a templet as with one, and that time spent on a templet is virtually lost. I think this is claiming too much for the method. Whether a templet is needed or not depends upon certain conditions and standards. To say every die should be made to templet is the opposite extreme.

The first thing to be considered is whether the die is likely to be duplicated in the future, and another condition is the actual shape or outline. In a plain segment die, where the punch is in one piece, with dovetails attached, it is a simple matter to make the punch first, use it as a templet by which to construct the die then ease it off to suit the thickness of stock to be punched, and finally place it in position in its holder. Where the punch is soft, inserted hardened parts can be used at dovetails, holes, keyways, etc., but when the outline is broken or irregular (as many of the recent designs are) and when these projections or depressions have to match when the blanks are overlapped, the templet method is the best; for tho it takes time to make a templet there are conditions when this time is more than saved, because much more rapid work can be done on punch and die by reason of having the templet. Measurements that would have to be retested many times can be determined at once and irregular outlines are more rapidly and accurately fitted if a templet is used.

The standard of accuracy required is a governing factor. While scale measurements were good enough ten years ago, they do not meet present requirements. The work limits mentioned by Toolmaker are not intended to provide for equal inaccuracies in the punch and die. These must be within close limits, and each concern will have its own standard of refine-

ment. As error in the blank is likely to be doubled in the piling, higher standards are called for, and the toolmaker who cannot use a vernier is not likely to find a job on armature die work. It would be interesting to hear from others on this work; no doubt there is a field for each method. Conditions and standards will determine the choice, and perhaps the man will have something to say in it, too; for unfortunately, we do not all do the same thing in the same way. A. B. C.

Peterboro, Ont.

Device for Cutting Tube Holes in Boiler Heads on a Lathe.

The illustrations show a device we made several years ago for cutting tube holes in boiler heads for our neighbor, the Moline Boiler Works.

Ours was a very small and poorly equipped shop, but we were hot after business, and as the good-natured old boilermaker offered us the work if we could do it, we rigged up an old lathe in this way and made it a profitable tool for many years.

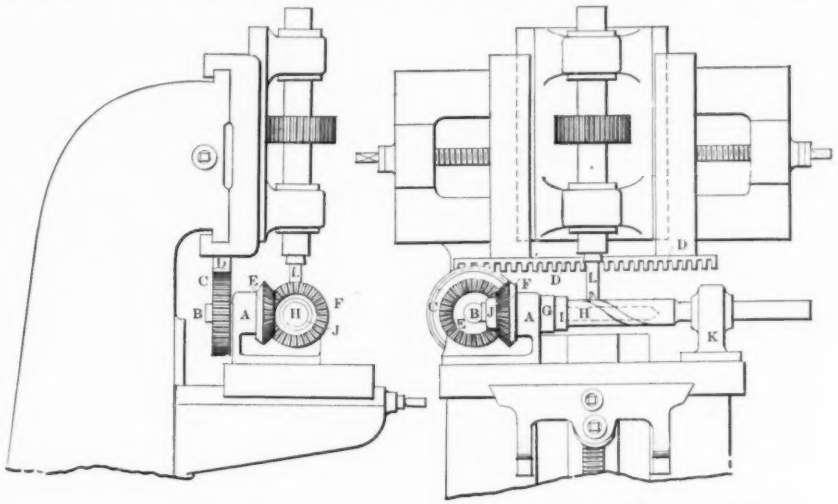
The cutters were like the drawing. They worked well, and were notable chiefly by the method in which their cutters were formed for clearance on a lathe. They were set in the "head" by blocks and shims, slightly tipped, the head being on a mandrel and the lathe tapering a little—the cutters were turned on the outside; then they were tipped in the reverse direction and the taper set opposite and an inside cut taken which thus left them relieved in all directions; they were then sharpened, pointed and flat alternately, and after tempering were set back in the head without the tipping shims. A set of cutters was made very quickly in this way, and they were good.

MAURICE R. WILLIAMS.

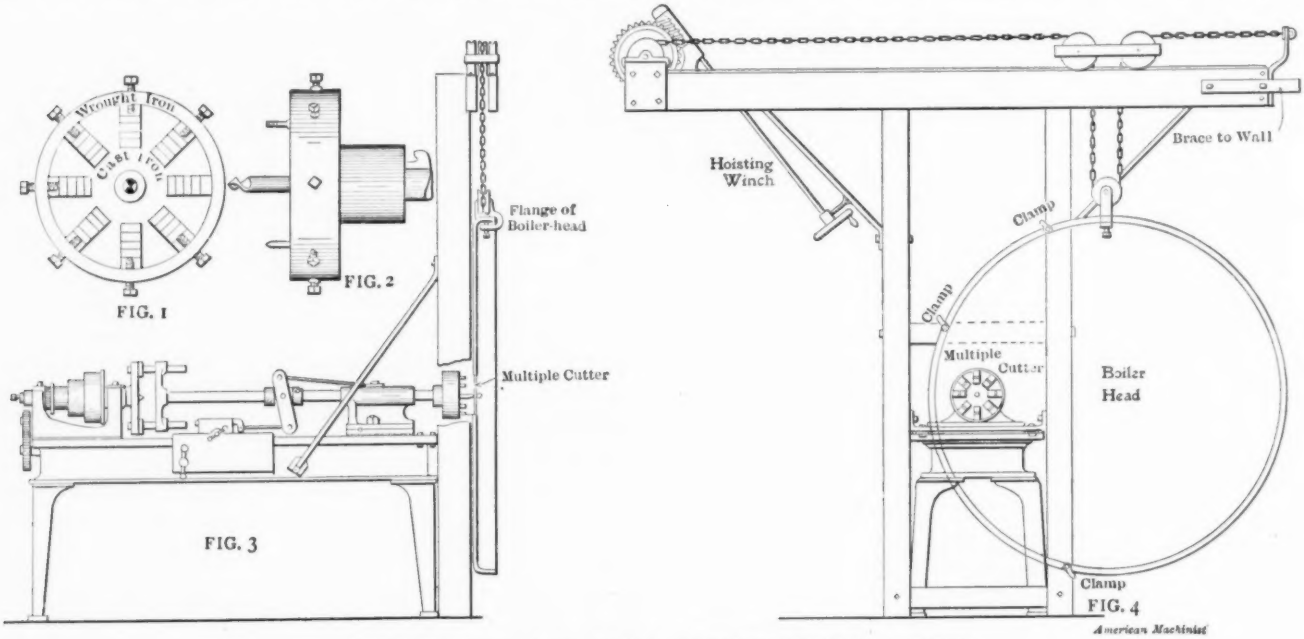
Cutting a Spiral Groove With a Slot Drilling Machine.

Having a quantity of hollow spindles 2½ inches outside diameter with a 1½-inch hole, which required a spiral groove or keyway ½ inch wide, and 18 inches pitch, cut as shown in the sketch. This would have been an easy task had we possessed a universal milling machine, but as we had not it was successfully accomplished on a slot drilling machine as shown. *H* is the spindle to be milled, *I* is a solid collar turned on it about 9 inches from the end, the other end being reduced to 1¾ inches diameter, as shown. *A* is a long hub turned on it which projects thru the bracket *A*, and has a collar *G* fastened on the back by a headless set-screw; this keeps the wheel in position. *J* is another collar cast solid with *F*. A headless set-screw passes thru this and into the shaft *H* and drives the work. *K* is another gray-iron bracket bored to receive the end of the shaft, thus steadying it. *D* is a rack, taken off an "American" lathe and fastened to the under side of the traveling saddle, as shown, and meshes with the wheel *C*. It will be seen that as the saddle moves backward and forward it will rotate the shaft *H*. *L* shows the 1½-inch slot drilling tool for cutting the spiral. The bracket *K*, gray-iron bracket planed on the bottom, and bolted to the table. The two bosses on the top are bored at right angles. One hole receives the shaft *B*, which carries the spur wheel *C* at the back end and the miter wheel *E* on the front end. *E* gears with the miter wheel *F*. Wheel *F* has a It works very satisfactorily and makes a very good job. We have now done a great many spindles this way with pitches varying from 12 to 18 inches, each different pitch of course requiring a change of the spur wheel *C*.

RIVETTER ENGLAND.



CUTTING A SPIRAL GROOVE WITH A SLOT-DRILLING MACHINE.



DEVICE FOR CUTTING TUBE HOLES IN BOILER HEADS ON A LATHE.

Fixture for Milling a Dovetail in a Steel Slide.

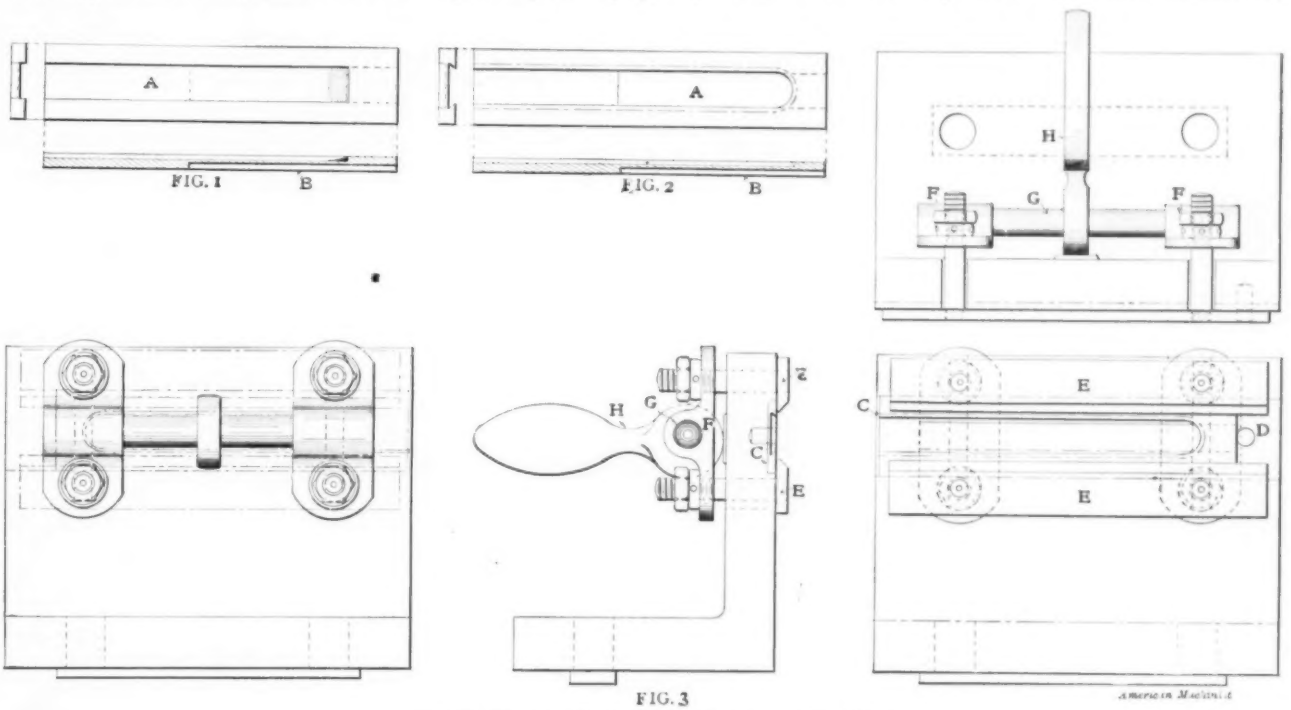
In Fig. 1 is shown a tool steel blank, 5 inches long, 1⅛ inches wide and 7-32 inch thick. This blank, after being milled all over to accurate measurements, is held in a gang milling fixture, together with six of its fellows, and a clearance cut milled in one side, as is indicated at *A*. The blank is then reversed in the fixture and a square bottomed cut *B* is let into the opposite side. This cut is not so long as the first. All this milling is done in a manner which insures perfect interchangeability.

The finishing operation consists of taking a dovetail cut thru one clearance channel, finishing the blanks as shown in Fig. 2. For this work the fixture shown in Fig. 3 is used.

The body of the fixture, which is of machine steel, is in the form of an angle plate, with two holes thru the base for the bolts which fasten it to the miller table. *C* is a seat milled in the fixture face, and *D* a stop pin for the work. The two plates *E* which clamp the work securely into its seat are drawn back by four studs which are secured in the plates and which project thru the angle plate, their rear ends passing thru yokes *F* and carrying, as shown, adjusting and jam nuts. Rod *G* fits easily into both yokes and is fastened permanently in the eccentric clamping lever *H*.

When this lever is pulled upward the clamp plates leave a free passage for the entrance of the work, which is slid into the seat and located against the stop pin. The lever is then forced downward, clamping the work, and the table is moved forward until the small angle cutter touches the work, when the feed is thrown in and the dovetail cut taken.

JOSEPH V. WOODWORTH.



FIXTURE FOR MILLING A DOVETAIL IN A STEEL SLIDE.

Questions Asked on Both Sides.

Recently a letter came to us about like this:

Gentlemen—Blank T. Blank has applied to us for the position as foreman of our machine shop. The place is temporarily vacant, and we are in search of a competent man to fill same. Mr. Blank has referred us to you, and you will oblige us by answering the following questions:

1. Is Mr. Blank what you would consider a first-class mechanic and manager of men?

2. Was he ever in your employ, and, if so, how long?

3. If in your employ, why did he leave?

4. Does he use tobacco or intoxicants?

5. Is he related to you?

6. Has he any property?

7. Has his wife any property?

8. Does he have to depend upon a salary solely or has he other interests?

9. How many concerns has he worked for, so far as you know, and at what salaries?

10. Why does he apply to us for a position when business is very good in your locality and wages are as high as here?

After reading a little like the above, one can readily understand why the place is "temporarily vacant"; but the most difficult thing in connection with it is to answer the letter and tell the writer of it your opinion of him without getting yourself into the hands of the postal authorities. It takes a polished diplomat to undertake this task, and not the one who has to do with the cutting of metal.

Of course the best thing to do is to keep a friend from accepting a position in such a place, but it is sometimes impossible to reach him.

A great deal has been said in the columns of the AMERICAN MACHINIST relative to the recommendations which the employer should furnish, but we never hear of him giving references. The employment agencies should protect those looking for positions, especially when they are paid by those who fill the places.

I have in mind a concern which has had in its employ in the last five years five chief draftsman and the last one was no more satisfactory than the first, yet all of these men are holding good positions with other parties and seem to be giving satisfaction. Some of the men who held the above position moved their families several hundred miles only to be moved again within a few months. Now, since the employer is in such fear of being "stung" I suggest a form of letter for the fellow looking for a position. Here is one which is of as much importance to the prospective employee as the one at the beginning of this is to the employer:

1. Are you a judge of a man's ability or do you rely upon what you are told by an organization of "knockers" which exists in most large shops?

2. How long has the present vacancy been filled by one man?

3. Why did he leave?

4. Do you drink cocktails before eating or smoke black cigars after?

5. Why are you looking 'round in this locality for a man when wages are as good in your own and men are standing on every corner?

6. How many superintendents, chief draftsmen, foremen, etc., have you had in the last six weeks? State how long each one was with you.

7. Is it your intention to allow me to exercise any judgment, or do you wish to do all of that?

These questions would give a prospective employee a "line" on his man without asking about his personal appearance and the color of his wife's hair, etc., all of which may be important but things which are really unnecessary. ART ISAN.

A Mechanical Conundrum—The Loose Pulley.

When reading the periodically recurring articles on remedies for the loose pulley nuisance one may be pardoned for asking the question, why should such remedies be necessary? Why is it that manufacturers keep on selling us otherwise excellent machines, and then give us a countershaft that can be kept in order only by being oiled every day, and taken down once a month for a thorough cleaning, and in addition require the loose pulley to be rebored and bushed every three or four months? It is a very common thing to see a loose pulley intended to run from 300 to 1,000 revolutions per minute with a very tight belt provided with no means for oiling except a hole drilled thru the hub.

We all know what a nuisance it is to have to send somebody aloft with oil cans, wires, monkey-wrenches, screw-drivers, etc., to try to persuade a loose pulley to keep quiet for a while. There appears to be no excuse for the evil, for there is no good reason why it could not be avoided by proper design. It is not that we do not know of means of preventing; all that is necessary is to make room for a supply of oil that will last from two weeks to a month and provide some inducement for the oil to stay somewhere near the shaft, and, incidentally, make the pulley wide enough to allow the use of a belt that will give ample driving power without being unduly tight. And these good things can usually be provided by the manufacturer at an additional cost of a couple of dollars, at the most, and we would be relieved of that distressing squeal that every once in a while reminds us that somebody has not done his plain duty.

In Fig. 1 is shown a form of loose pulley that will run a long time with one oiling. The drawing explains itself. The pulley has cored in it a large annular reservoir, and the bushing has a number of holes drilled thru to allow the oil to reach the shaft. Before the bushing is pressed into the pulley, the cavity should be filled (but not stuffed) with wool. And, judging by results, no designer of loose pulleys seems to know that a composition bushing works better on a shaft than a gray-iron one, so I beg leave to state that I have found this to be the case, and would recommend that the bushing be made of composition.

In trying to improve a little upon existing conditions, I have found the scheme shown in Fig. 2 very efficient and very cheap. Turn the end of the loose pulley hub straight, and bore the collar shown to a tight fit. Drill a number of oil holes thru the hub, fill the cavity with wool, and

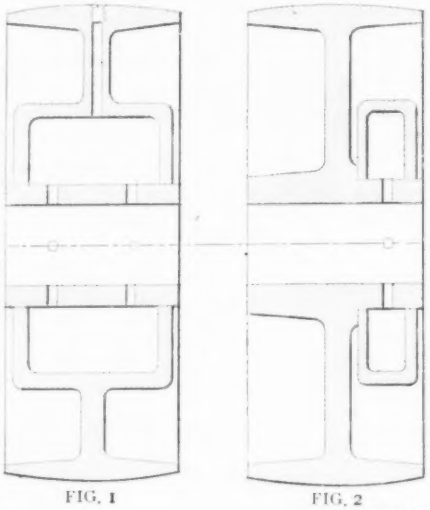


FIG. 1 FIG. 2

ANOTHER LOOSE PULLEY PRESCRIPTION.

press the collar on. Of course, the collar has a tapped hole, closed with a screw or "something just as good" for the introduction of oil. Also, there would be no objection to treating both ends of the pulley in the same way. I find that three different patterns will generally be all that is necessary, as the same collar can be used for several sizes of pulley hubs. Simply bore it out a little larger or smaller, as the case may be. The first cost is small, and it will pay for itself in a very short time.

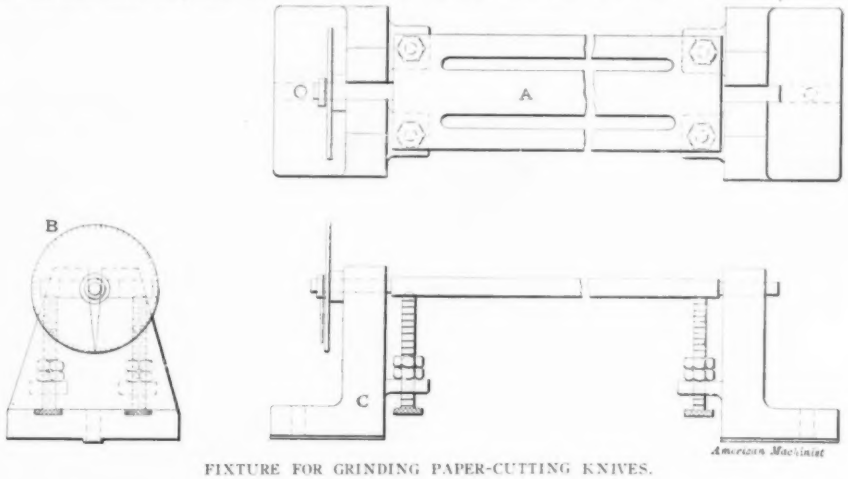
For webbed pulleys I prefer to cut out the entire hub of the pulley, and use a reservoir like the one shown in Fig. 1, cast with a flange on it, and the web of the pulley screwed to this flange. The bushing can be made long enough to suit the width of pulley and with a couple of patterns for the oil reservoir, say one 3 and one 5 inches long, it is possible to fix most loose pulleys in this way. It is preferable to Fig. 2, as it can be made with more room for oil, but either will be found an improvement on existing conditions.

H. K. HARRING.

Fixture for Grinding Paper-Cutting Knives.

The accompanying sketch represents a fixture for grinding knives used in machines for cutting paper and pasteboard. Having several of these knives, ranging from 2 to 5 feet in length and 5 inches in width, and finding it inconvenient to block the piece up with a wooden frame and wedges set on the table of the grinder, the following method was resorted to. Referring to the sketch, *A* represents a gray-iron plate having a bearing at each end and two slots milled nearly the full length of the casting. The knife is strapped to the plate by means of bolts in these slots, the edge of the knife slightly overhanging the edge of the plate. *B* is a graduated gray-iron disk with a hub, driven into a counterbore in the support *C* and keyed there, the hub formed at the end of the plate running thru the hole bored thru the disk. The supports are gray-iron castings, the lugs shown being tapped for the set-screws which adjust the plate *A* to the required angle for the work. The pointer for reading this angle on the disk is pinned to the hub or trunnion at one end of *A*.

The angle to which the plate is set with the horizontal ranges from 12 to 20 degrees, and may be read off directly on the disk. The four set-screws provide all necessary adjustment, as movement sidewise is unnecessary, as the drilled holes in the knife coincide exactly with the slots in the plate. The grinder in question is one used for cylindrical work, and has longitudinal and cross feeds. When the supports *A* are bolted to the table and the knife strapped to the plate, adjustment is speedily secured and the job quickly and accurately accomplished. Should any vibration occur in the plate, a small jack-screw may be placed under it.



FIXTURE FOR GRINDING PAPER-CUTTING KNIVES.

W. T. M.

Making the Best of Present Units.

BY SANFORD A. MOSS.

The metric system has not yet come, and we must still make our computations in the old units. Why should we not make the best of the matter and endeavor to straighten out the units we have, rather than to spend time deploring the fact that we have not, or arguing that we ought not to adopt the metric system? The most rabid anti-metric man must admit that our present system can be straightened out a little at least.

One great reform is slowly but surely coming along irresistibly. This is the abandonment of fractions and the use of decimals instead for mechanical engineering work. The widespread use of the micrometer caliper is partly responsible for this. Machinists now work to .01 and .001 inch with facility, and a hole is now bored to 3.004 inches instead of to "the long 3-inch mandrel in the toolroom, plus a time card." It is now standard practise in many shops to give some of the dimensions on drawings in decimals of an inch, the majority of the dimensions being in fractions, however. A few shops use decimals altogether on drawings. Many United States Government drawings are made in this way, and the practise is growing. I venture to predict that in a few years it will be standard practise to have all dimensions on mechanical drawings in decimals of an inch. This is certainly a consummation devoutly to be wished for, and its advent should be hastened.

There is also a growing tendency to use the pound and decimals of a pound for weighing of all kinds. If ounces, tons and grains could be eliminated entirely we could get along very well without grams and kilograms. Scales graduated to one-tenth of a pound, which can be read by estimation to .01, can now be easily procured and will be found much more convenient than those graduated to pounds and ounces. Scale companies would probably find a demand for such a graduation if listed regularly. All engineering laboratory work can very conveniently be carried on wholly in terms of pounds and hundredths, and an effort should be made to do this universally.

For measurement of pressure, the "pound per square inch" is now used almost exclusively in this country, so that the pressure question is not troublesome. In fact, it is doubtful if the metric system covers definite units of pressure. The proper metric unit of pressure is probably the kilogram per square centimeter, but "millimeters of mercury" and "dynes per square centimeter" are often used as standard metric units. If desirable the "pound per square inch" could be made an absolute unit by defining it as the force on a square inch due to the weight of a pound at sea level and 45 degrees N. lat.

Unfortunately it is still customary to measure vacuum in "inches of mercury," although many are beginning to use "pounds per square inch absolute." That is to say, instead of saying that the vacuum is 26.7 inches and the barometer is 30.5 inches, the absolute pressure is given as 1.86 pounds per square inch. This seems to be the only rational method, and it will undoubtedly come into general use.

There is no good reason why barometic pressures used in engineering work should not be wholly in pounds per square inch. A barometer with a pounds per square inch graduation will be found very convenient. Mercury columns with pounds per square inch graduation are also easily procured and very convenient. Of course a temperature correction table in terms of pounds per square inch would have to be used for accurate work if barometers and mercury columns are thus graduated.

Air pressures are often measured in ounces per square inch, but it would conduce to uniformity if decimals of a pound per square inch were used instead.

I have had a great amount of computation work to attend to, and have found the adoption of a definite system of units very convenient. In fact, if some definite system is adhered to, the situation as regards our miscellaneous American units is not so black as it is sometimes painted, and computation work is not seriously hampered by units.

I have found the following system exceedingly convenient and have adopted it for all computations, including theoretical algebraic engineering work, as well as numerical work. The system is a *compromise* between *custom* and *convenience in calculation*, and has proven quite satisfactory for some time.

For all computations concerned with stresses and strains, deflections, weights of machinery and other work concerned directly with mechanical drawings, the *inch* is the unit of length. For sub-division, decimals of an inch are used.

Pressures and stresses are always in *pounds per square inch*, with decimal subdivision. The use of the pound per square inch, instead of the pound per square foot, requires the introduction of the factor 144 in many cases; but this is more convenient than the use of two kinds of pressure unit.

All other units follow the *foot-pound-second system*, with decimal sub-division. This requires that lengths be expressed in feet and decimals of a foot, and *for general work this is most convenient in the end*. If dimensions are given in inches, or if the result is desired in inches, the translation can easily be made before or after the computation, so that the computation itself can be carried on in feet exclusively. Areas and volumes are in square feet and cubic feet.

For work other than stresses, strains and weights, requiring the use of drawings, the computation is carried on in inches as long as the drawings are used, and then translated into feet for the actual computation work. For instance, in a computation involving the kinetic energy of a rotating body, the moment of inertia is computed from the drawings in terms of pounds x (inches)^2. It is then divided by 144 and used in the actual computations of flywheel effect, etc., as pounds x (feet)^2.

The use of the second as the unit of time also requires that rotative speed be in revolutions per second and velocities in feet per second. Here again the second is the most convenient unit for general work in the long run. If revolutions or feet per minute are given or required, the translation can be made before or after the main computation.

Weights and mass are of course always expressed in pounds and decimals of a pound.

For temperatures, Fahrenheit absolute is used. Any temperatures given in ordinary Fahrenheit are at once translated to absolute by the addition of 460.

The unit used for quantity of air is a "cubic foot of free air." Free air is understood to be air at exactly 14.7 pounds per square inch pressure and 520 degrees absolute or 60 degrees Fahr. temperature. A cubic foot of free air is, therefore, a unit of weight just like a pound, but smaller, being about 1-13 pound. This unit is used just exactly as a pound would be, but is much more useful, owing to the property that unit weight has unit volume at standard conditions. The cubic foot of free air has long been used in air-compressor work, probably never as an exact quantity, however, but varying with atmospheric conditions. I have found the use of the exact unit defined above to be very convenient not only for air-compressor work, but also for general thermodynamics of compressed air, gas-engine work and work with blowers and centrifugal fans.

For energy, the British thermal unit and the foot-pound are used interchangeably, the factor used being 778. This is the only case where a double unit is permitted.

For power, the "horse-power," 550 foot-pounds per second, is used.

West Lynn, Mass.

No. 2248 of the *Daily Consular Reports*, issued by the Department of Commerce and Labor, is devoted to the subject of the hours of labor in European shipyards, information on this point being sent in by the various United States consuls residing at the points where foreign shipyards are located.

"Unless a man employs some men cleverer than himself he can never become great."—*Graphite.*

Unless a man is able to perceive and broad enough to say that some men employed by him are, in some things, cleverer than himself he never can become great.

AMERICAN MACHINIST

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Decimalized Units vs. The Metric System.

We publish elsewhere in this issue an article by Sanford A. Moss, in which he presents some arguments, and some facts derived from his practise, intended to show the desirability of simplifying our present units somewhat. What Mr. Moss proposes is in line with efforts being made by certain persons in Great Britain looking toward what is called the decimalization of British units. Indeed, the secretary of the British Weights and Measures Association, an association formed for the purpose of resisting the movement toward the adoption of the metric system, has expressed the opinion that it will be impossible for the association he represents to long resist the tide toward the adoption of the metric system unless the present British units are decimalized. On the other hand, other opponents of the metric system seem to be about as much opposed to decimals as they are to the metric system itself, and stoutly maintain that decimals are no better than, indeed not as good as, the common divisions of the inch.

As a matter of fact, it is difficult to see how machine shops could decimalize the inch with materially less trouble or expense than they could adopt the metric system. In fact, if "decimalization of the inch" were taken to mean that all parts of machines, and the tools for producing the same, were to be changed to integral decimal dimensions, then such tools would probably cost more than metric tools would cost, because metric tools of various kinds are now commercial articles, and are usually quoted at the same prices as the others, while tools made to decimal parts of an inch are not commercial articles, and there are no quotations on them.

Of course a machine shop may provide itself with decimally dimensioned tools gradually, as its work may require, or it may do it all at once; but in the end, the necessity for providing them would be about the same as for providing metric tools in case that system were to be adopted, and whatever of difficulty or expense might be encountered in one case would be encountered in the other.

If it is true, as so stoutly maintained by some, that the expense to machine shops would be enormous if the metric system were to be adopted, then it seems to us it would be scarcely less if the decimalized inch were to be adopted. Yet there is in England a decided sentiment for decimalization of the inch, and more or less belief that in such decimalization lies the only hope of long preventing the adoption of the obnoxious metric system. Aside from this, however, Mr. Moss' article contains, we think, suggestions of value.

A contemporary discussing recently the subject of secrecy in technical work and felicitating itself upon the increased publicity given of late to such work, mentions the fact that a recent union of tanneries showed that the jealously guarded secrets of each plant were well known in all the other plants, before the amalgamation. We think it is safe to say that, in most cases, this will be found to be so, and that the very things thought to be the most valuable secrets in a manufacturing establishment are the things which are best known in the shops of its competitors, it being, to a certain extent, the business of a man engaged in a certain line of work to know what the state of the art is, and as much as possible of what others in the same line are doing and how they are doing it.

Ownership of Public Utilities.

By the recent vote of the citizens of Chicago, by the investigation recently made of the doings of the gas company which controls that service in New York, by the emphatic and clear endorsement by Andrew Carnegie of the principle of municipal ownership of public utilities, and by other events, the question is coming to the front and as the trend of events will inevitably affect machinery interests more or less, our readers are, sooner or later, bound to take an interest in it aside from, and perhaps more earnest than, that which they take as citizens merely.

As is to be expected in all such matters, there is a great deal of misrepresentation of the subject, some of it based upon pure ignorance probably, and some other upon a desire to mislead. We think, therefore, that our contemporary, *Engineering News*, renders a service to its readers when it publishes, as it does in its issue of April 20, a plea for calm and sane consideration of the question. After referring to the fact that the term "municipal trading" had been invented in England and applied to public ownership of public utilities in order to misrepresent and discredit it, our contemporary mentions the revelations pertaining to the gas company in New York, and says:

"A more damning revelation of the exploiting of a great municipality for the enrichment of a ring of promoters and stock-waterers it would be difficult to imagine."

By way of contrast there is reprinted a few paragraphs of a paper read before the Association of Municipal and County Engineers at its annual meeting held at Cleckheaton, England. These paragraphs show that the local electric light plant, which was originally constructed by a private company at a cost of £53,000, was purchased by the municipality, altered and enlarged to meet a growing demand for gas; the price of gas to consumers reduced from $1.08 to 56 cents per thousand feet and public lighting done without cost to the taxpayers, while yet the profits have been such as to enable a large part of the original capital account to be paid off.

Engineering News calls attention to the fact that these figures are not put forward as any part of a municipal owner-

ship propaganda, nor as anything unusual or remarkable. They are simply part of a description of a local works of a town in which a meeting of engineers happened to take place, and it adds, "If 'municipal trading' can show such results as these, the public is pretty certain to favor it, no matter what bad names it may be called."

Our contemporary, however, does not touch upon what is with many the chief argument in favor of public ownership and operation of public utilities, and that is the fact, plainly shown by many exposures during the past few years, that private ownership of public utilities is the most fruitful source of political corruption in America.

The men who own or control public utilities have large responsibilities; they are very able men; they feel that they must protect by every means in their power the interests of themselves and the other capitalists associated with them. They know that the property they control is subject to attack by hostile legislation and by adverse court decisions. What more natural, therefore, than that they should take means to promote the election of men whom they can control or influence? That they habitually do this, no intelligent American can for a moment doubt. Having such men elected, let us say to a State legislature—men knowing that their election is due to the money of certain public service corporations—it is to be expected that the sort of men they will inevitably be will be open to any kind of propositions relating to other public questions that may present themselves. In other words, having sold themselves to, let us say, a railroad so far as railroad legislation is concerned, they very naturally are open to engagement by any other "interests" which may be seeking legislation, wherein railroad interests will not be affected, and the rights and interests of the public will be entirely ignored.

Only thoughtless enthusiasts will imagine that with municipal control of public utilities all difficulties of every kind will disappear, but at least it will be within the power of the public to make a change in management when such a change seems to be imperatively demanded.

In the meantime a plan proposed by Mayor Johnson, of Cleveland, who it will be remembered was a prominent manufacturer, inventor and street railway owner, is being highly commended even by some who are opposed to municipal ownership of street railway lines. His proposition is that a holding company composed of men satisfactory to the city and to the owners of the railways shall be organized to operate the roads of the city. It shall pay to the stockholders certain specified dividends and shall maintain the roads in good condition. The specified dividend is to be large enough to be a fair return on capital invested, and any failure to pay it or to keep up the condition of the roads is to result in the immediate return of the roads to their original owners. Thus municipal management will be put upon trial under such conditions as would seem to safeguard the rights of everybody concerned, and some of those who believe that municipalities cannot successfully manage such things, as well as some of those who believe they can, are hoping that the plan will be tried.

The Hammer and the Blow.

Not long ago certain very competent mechanics of our acquaintance acquired some experience which, as often happens, was quite expensive and which, now that the experience is theirs, it seems to them, as well as to others, might have been acquired more cheaply. It related to a certain machine designed to make holes on the percussion principle in hard material. Older machines for this purpose depended upon alternately raising the drilling tool and dropping it or forcing it downward into the bottom of the hole; rotating it slowly at the same time. The new machine was intended to work on a different principle, *a la* pneumatic hammer, and to have a hammer within the machine itself, to be driven by compressed air against the upper end of the drill, the drill itself not being raised and lowered for each stroke. It was expected that the blows could be delivered much more rapidly in this way, and that the machine would possess other advantages. All went well until a certain depth was reached, at which depth it was found that the only effect of the hammer was upon the upper end of the drill and that it simply upset or battered it. No effect was produced at the bottom of the hole; the reason being, of course, that the increased length of the drill had given it sufficient mass to resist the force of the hammer blow, which was expended in simply upsetting or riveting over the head of the drill. It was, after all, only another illustration of the long well-known fact that a hammer must be proportioned to the weight of the tool it is to drive or to force into the material. If you take a hammer weighing an ounce and strike it on top of a crowbar, you will produce no appreciable effect at the other end of the bar, but if you keep it up long enough you will gradually wear out or disintegrate the end of the bar on which the hammer strikes; no other effect being producible by such a hammer.

An Engineer's Record.

The thirty-third annual report of the House of Correction of the city of Chicago contains as its only portrait that of Robert Calladine, the engineer of the institution for the past thirty years.

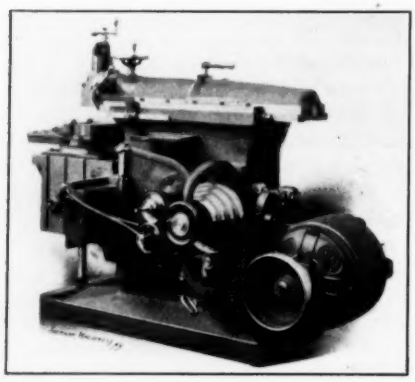
Born in Niagara Falls in 1846, and subsequently graduating from the public schools, he entered the employ of the New York Central Railroad, working up to be engineer on the Buffalo division, and in 1865 came to Chicago, entering the employ of the Northwestern road. After seven years' service in various positions with that corporation, he left its employ and became consulting engineer for various Chicago firms, and in 1875 was appointed chief engineer of the House of Correction. With the many changes of political life, and administrations coming and going, he has invariably been reappointed. Most of the institution has been built under his supervision, and especially the various power and electrical plants, while all of the heating, lighting, sewering and water systems have been installed by him and his "trade classes." He has probably taught more prisoners the principal points of such occupations as fireman, water tender, steamfitter, engineer, dynamo tender, sheet-metal worker, lineman, electrician, millwright, plumber, etc., than any prison official in the country, and one noticeable fact is that the average prisoner who had no mechanical training when received and was taught it while here, has seldom returned. It is especially gratifying to record that in the thousands of prisoners assigned to his department, unskilled and without any previous experience, many of them ignorant, that not a serious accident has befallen any of them during these thirty years, and it emphasizes the care and the judgment shown by him in the treatment of his men. If "he who makes two blades of grass grow where one grew before" is a public benefactor, surely "Uncle Bob" with the care, attention and training that he has given thousands of unfortunates in order to fit them for a better place in the industrial world and teach them better habits of living, is a benefactor whose work should be even more appreciated, for without question it has been the turning point in the career of many prisoners.

An attractive display advertisement has recently appeared in some of the Toronto papers appealing to salaried employees who may need some ready money, which may be had upon loans secured by liens upon household effects. The inducements offered to effect such transactions are easy payments; no publicity; no enquiry from relatives, friends or employer; money can be had in two hours' time if necessary. Payments can be made weekly, semi-monthly or monthly. Ten cents a day pays a loan of $10; 19 cents a day pays a loan of $25; 24 cents a day pays a loan of $50. These terms are exceedingly favorable—to the lender. Most financial institutions are quite glad to let out their money at 6 per cent. per annum, which, on $10, would be 60 cents; on $25, would be $1.50; and on $50 it would be $3. The money lender, however, who loans the poor borrower $10 demands for the use of it at the rate of $36.50 per year; which, if not paid according to agreement, means that the household effects of the borrower are seized and sold by the bailiff.—*Canadian Manufacturer.*

New Tools and Machine Shop Appliances.

MOTOR-DRIVEN SHAPER.

The half-tone shows a 24-inch back-geared crank shaper, with motor drive. The machine shown is at the Liege Exposition, Belgium, and is equipped with a foreign motor, which accounts for the feet of the motor not fitting the motor pad. The pad is hinged, and is provided with set-screws to swing it and a swivel bolt to hold it when tightening the belts. The motor used in this case is constant speed, hence the cone pulleys. The wooden hand wheel on the cone-pulley shaft is for moving the ram by hand. The handle below the cone pulley is for throwing the back gear, and the curved lever at the side of



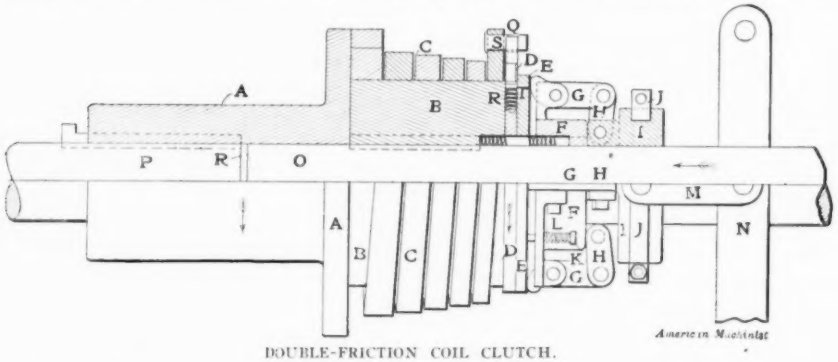
MOTOR-DRIVEN SHAPER.

the machine operates a brake. This machine can be supplied with power down-feed, revolving and tilting table, etc., etc. It is built by the Cincinnati Shaper Company, Ohio.

DOUBLE-FRICTION COIL CLUTCH.

The clutch here shown is of the type in which the connection between the two parts is made by the winding up of a coil spring around a chilled steel drum. The manner in which this is done is quite apparent from the illustration. At the right-hand side is seen the operating lever *a* which connects with the links *b* to the operating collar *c;* the motion of this collar is transmitted to the link *d* and the lever *e* to the friction plate *f*. This plate normally revolves loosely on the shaft and bears against the latch plate *g*, which also is loose on the shaft. The friction thus produced between the friction plate *f*, the latch plate *g* and the end of the chilled drum *h* retards the free movement of the latch plate and brings the latch *i* to bear on the coil pin *j*. The obvious result is a winding up of the coil, causing it to grip tightly the drum *h* and so locking together the two parts of the clutch. The hub *l* is fast to the driving shaft *k*, and the coil is fastened to this hub.

The clutch is released by moving the lever *a* to the right, which allows the springs *m* on the studs *n* to release the pressure on the friction and latch plates and so allow them to again revolve freely and hence release the tension on the coil spring. From the construction of this clutch, it is apparent that it is very powerful, and that in both making and breaking the connection between the two parts the action is gradual and not one of sudden shock. The maker is the Double-Friction Coil Clutch Company, Chicago, Ill.



DOUBLE-FRICTION COIL CLUTCH.

MOTOR-DRIVEN ENGINE LATHE.

The accompanying illustrations show a lathe with a three-gear speed headstock and a variable-speed motor, these lathes being the product of the Seneca Falls Manufacturing Company, of Seneca Falls, N. Y., and the motor of the Northern Electrical Manufacturing Company, of Madison, Wis.

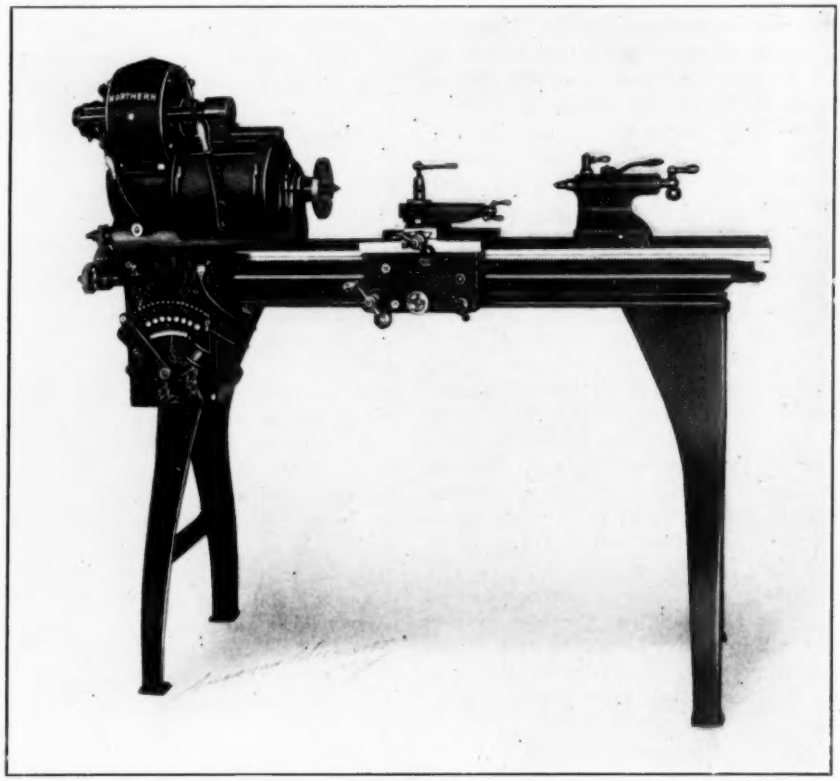
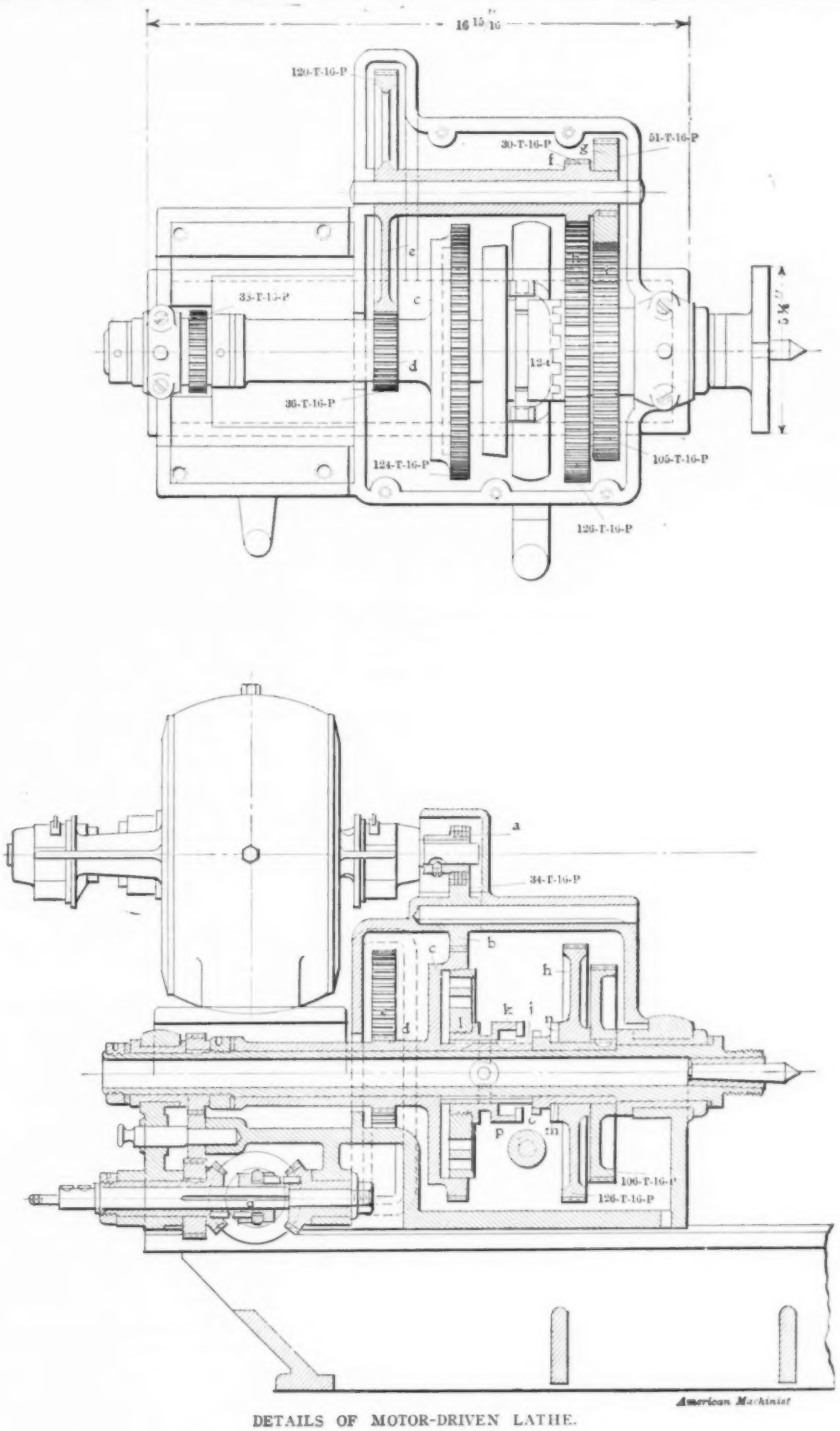


FIG. 1. MOTOR-DRIVEN LATHE.

Fig. 2 shows clearly the construction of the headstock and the method of connecting the motor. The rawhide pinion *a* drives the idler *b*, which in turn drives the receiving half *c* of a friction clutch. The quill of the clutch carries a back-gear pinion *d* meshing with back gear *e*, the opposite end of the back-gear quill carrying two pinions *f* and *g* meshing respectively with gears *h* and *i*. Keyed to the spindle is the sleeve *j* and keyed to *j* is the claw clutch *k* carrying also the entering half *l* of the friction clutch. Gear *i* is keyed to sleeve *m* while gear *h* runs freely on it. The left-hand face of gear *h* has clutch teeth *n* fitted to engage corresponding teeth in clutch *k*, these teeth being engaged when the clutch is in the extreme right-hand position. The left-hand end of sleeve *m* has also clutch teeth *o* fitted to engage inwardly projecting teeth on clutch *k*, these teeth being engaged when the clutch is in its mid-position. The control of the clutch is by a lever *p* and external hand lever as shown in Fig. 1.

In the position of the clutch shown in the plan section, the drive is thru *c d e f h k j* to spindle; in the position shown in the vertical section thru *c l k j* to spindle and in the intermediate position thru *c d e g i m k j* to spindle.

The left-hand end of the friction clutch quill drives the feed gear, thru bevel gears with a clutch at *q* and an external hand lever shown in Fig. 1, serving to reverse the feed.



DETAILS OF MOTOR-DRIVEN LATHE.

The Buda Foundry & Machine Company, of Chicago, Ill., has brought out a new anti-friction metal which is claimed to possess exceptional qualities.

New Publications.

"A Treatise on Concrete, Plain and Reinforced." By Frederick W. Taylor and Sanford E. Thompson. 585 6x9-inch pages with 176 illustrations. John Wiley & Sons, New York. Chapman & Hall, London. Price $5.00.

This is a very complete and even elaborate treatise upon concrete, covering especially the use of the material and, to a lesser extent, the manufacture of cement, both Portland and natural, altho of course Portland cement receives by far the larger amount of attention. The use of the material for both civil engineering and architectural constructions is covered, some phases of the subject being treated in special chapters by experts other than those who appear as the main authors of the book. While the subject is chiefly of interest to civil engineers, the increasing use of concrete in the construction of factory buildings makes the subject of increasing importance to all engineers and manufacturers; and while such readers will not find it advisable to read the entire book, they will find such information as they need clearly and directly given, the chapters on reinforced concrete and building construction being especially full and complete.

"American Telephone Practise." By Kempster B. Miller. Fourth edition. 888 7x10-inch pages, with 643 illustrations. The McGraw Publishing Company, New York. Price $4.00.

This edition of this well-known work is very greatly enlarged over the previous editions and in fact has been almost entirely rewritten—a course of procedure which has been in large measure necessitated by the rapid developments in telephone practise. Subjects which were barely touched upon in previous editions have now been expanded into lengthy chapters. The author has resisted the natural tendency to devote much space to historical matters, and in fact has found it necessary to cut out much material of this class which appeared in former editions in order to provide room for new methods and developments. Only such obsolete methods and equipments are now included as are of distinct educational value, or of more than ordinary historic interest. The illustrations are very numerous and complete, and comprise half-tones from photographs of complete apparatus, reproductions of sectional drawings and wiring diagrams. The book is a complete compendium of telephone practise, and includes almost every phase of its subject except the mathematical one.

"History of American Steam Navigation." By John H. Morrison. 637 6x9-inch pages, with numerous illustrations. W. F. Sametz & Co., New York.

It is a striking fact that no previous attempt has been made to collect together the stirring events of the early history of steam navigation in this country, but the completeness and interesting character of this volume largely compensate for the delay. After a chapter on the experimental stage of navigation, the author takes up the subject in the order of its historical development. The narrative begins with the story of the work done on the Hudson river, where successful steam navigation began, and proceeds to the history of the Delaware river, Western rivers, Long Island Sound, the Great Lakes, ocean and coastwise steamship lines and ferryboats. The book is in no sense a compilation of matter already in print, the author having delved into original documents and records and corrected many prevalent er-

rors. The story is of absorbing interest, and includes many reminiscences of the rivalries, both mechanical and commercial, which accompanied the inauguration of steam navigation. The story of the rise, progress and downfall of the ill-fated Collins line is given, but the paucity of American achievements in salt water navigation, compared with the brilliant results obtained in the navigation of inland waters, is not pleasant reading to an American.

"Strength and Elasticity of Structural Members." By R. J. Woods. 310 5½x8½-inch pages with 292 illustrations. Edwin Arnold, London; Longmans, Green & Co., New York. Price $3.50.

This book is an analytical treatment of the strength of materials. It begins with a chapter on graphic statics, showing how the strains upon the individual members of a structure are found by graphical means, and then proceeds to take up the subject of stress and strain, defining the two and the various moduli which enter into the calculation of structural members. The stress strain diagram and compound stresses are then taken up in successive chapters, following which comes bending moments, moments of inertia, girders, deflection of beams, bending and direct stress, columns and struts, riveted joints, continuous girders, cantilever and suspension bridges, arch ribs and torsion. The book is quite mathematical, and is intended mainly for students of engineering.

"Industrial Education and Industrial Conditions in Germany." 323 6x9-inch pages with 12 full-page illustrations. The Bureau of Statistics, Department of Commerce and Labor, Washington.

This pamphlet collects together the remarkable reports upon industrial education in Germany by Deputy Consul Meyer, of Chemnitz, Germany, of which we published extensive abstracts last year. To these reports is appended a collection of information regarding industrial, commercial and educational conditions in Germany, which appeared in the London *Times* in the fall of 1903. Additional appendices relate to technical schools in France and commercial schools in Japan. A collection of half-tone illustrations showing exterior and interior views of many of the German schools serve in a most striking way to illustrate the great development of these schools, as well as to show how much behindhand this country is in educational work of this character. The reports by Mr. Meyer, especially, are of the first order of importance and value and should do much to awaken interest in the subject here. The pamphlet may be obtained for the asking, and it should receive a wide circulation among all who have any interest in this subject. There is not a teacher of science or of engineering in this country who will not have his eyes opened and his interest quickened by reading this volume. The magnificent facilities shown by the illustrations may well cause every American who is interested in industrial education to wince as he compares them with the paucity of such things in this country.

"Generator-, Kraftgas und Dampfkessel-Betrieb in bezug auf Waermeerzeugung und Waermeverwendung." By Paul Fuchs. 188 pp. 5½x8½. 42 illustrations. Berlin: Julius Springer. Price 5 marks.

This is a second edition of a book on "The Control of Steam Boiler Service," enlarged in scope, as indicated by the title. Explicitly, it is a brief treatise on processes, investigation methods, etc., relating to the transformation of combustibles in power-gas-generator and steam-boiler practise. The main divisions of the text are as follows: Heat production thru gassification and de-gassification (distillation) of fuels; production of heat by direct combustion; employment of heat for boiler, superheater and feed water heater purposes; and, finally, the methods of gas analysis and other matters of testing and practise. The book is based more or less on the personal experiences of the author.

"Alternating Current Machinery." By William Estey. 416 6½x9½-inch pages with 380 illustrations. American School of Correspondence, Chicago. Price $3.75.

This book has been prepared in order to give the beginner and practical electrician a working knowledge of alternating current apparatus. The mathematics involves nothing beyond simple algebraic equations and trigonometry of the most elementary kind. Graphical and geometric rather than analytical or algebraic methods have been adopted wherever possible with a marked simplification of the work. The book opens with an explanation of the essential features of alternating currents which is followed by descriptions of the leading types of machinery and the measuring apparatus used. A general acquaintance with the laws of electricity and magnetism on the part of the reader is presupposed. While the book cannot be called easy reading, it is within the comprehension of those who possess the acquirements referred to above.

"Street and Electric Railways. 1902." 439 9¼x11½-inch pages. Department of Commerce and Labor, Bureau of the Census, Washington, D. C.

This elaborate report is largely statistical, and contains an immense amount of information upon electric railways. Among the more important subjects discussed, are capitalization, financial returns, interurban railways, consolidation of street railways, franchises, public regulation and public ownership, street railways in European countries, construction of roadbed, track, cars, electric and miscellaneous equipment, construction and equipment of interurban railways, the equipment and output of power-houses, etc. In addition to numerous smaller tables scattered thru the text, one large section contains over one hundred special tables relating to traffic, accidents, capitalization, equipment, income, and, in fact, to pretty much every possible phase of electric railway work.

We have received from the Iowa State College, Ames, Iowa, Bulletin No. 9 of the Mechanical Engineering Section, which is entitled "Notes on Steam Generation with Iowa Coal," by G. W. Bissell, M. E

We have received (reprinted from the "Proceedings of the Society for the Promotion of Engineering Education") a paper by Prof. John G. D. Mack, of the Department of Machine Design, University of Wisconsin, on the subject of an "Industrial Catalog Library." In it will be found considerable useful information on the subject named, and especially to be commended is its insistence upon the importance of thorough indexing.

Inquiry for Machinery.

(182) We have an inquiry for a hollow spindle screw machine to take 1½ inches thru the spindle and swing about 9 inches and to run 5,000 revolutions per minute.

Personal.

Carl Baum, chief engineer of the North German Lloyd steamer "Kaiser Wilhelm II" recently completed his three hundredth round trip across the Atlantic. His record began forty years ago, and he has steamed 2,346,832 miles. He is now sixty-five years old and has never had an accident. He has seen his company's fleet grow from four iron single-screw boats to 200 steel vessels, many of which are twin-screw and of the largest class.

Manufacturers.

The Gardiner (Me.) Canning Company is erecting a plant.

The Anderson (Ind.) Canning Company is erecting a plant to cost $75,000.

The Syracuse (N. Y.) Bridge Company will remove its plant to McLean, N. Y.

The city of Monmouth, Ill., proposes to erect its own electric lighting plant.

The National Wheel Company, Perrysburg, O., will erect an addition to its factory.

The Prescott Company, Menominee, Mich., will erect a $100,000 steel casting plant.

I. L. Pearl & Co., Johnson, Vt., are erecting a new mill for the manufacture of woolens.

The Rockford (Ill.) Piano Action Company will erect a new factory, at a cost of $20,000.

The Elyria (Ohio) Machine Parts Company, capitalized at $200,000, will build a factory.

The Santa Fe Railway Company will build a power-house and electric plant at Argentine, Kan.

Henry C. Dahl, Philadelphia, Pa., will erect a $16,000 pickle factory for R. C. Chance's Sons.

The Pennsylvania Optical Company, Reading, Pa., is having an addition built to its plant.

P. E. Somers, Worcester, Mass., is having a factory erected, where he will manufacture tacks.

The National Enameling & Stamping Com-

pany, Baltimore, Md., is having a factory erected.

The Washburn-Crosby Company, Minneapolis, Minn., will erect a machine shop, to cost $40,000.

James Foster, contractor, of Philadelphia, Pa., was granted a permit to erect a six-story factory.

The American Tap & Die Company, Greenfield, Mass., is having plans drawn for a new factory.

The Lebanon (Pa.) Paper Box Company is enlarging its factory by the addition of a new building.

The Graff Furnace Company, New York, is improving and enlarging its plant at Dickson City, Pa.

The factory of the Brennan Shoe & Boot Company, Natick, Mass., was burned; loss, about $30,000.

The Holland Manufacturing Company, Baltimore, Md., making nails, tacks, etc., will enlarge its plant.

The Lakeside Malleable Casting Company, Racine, Wis., will erect a new foundry, to cost about $12,000.

The Wood Bros. Steel Self-Feeder Company, Des Moines, Ia., is planning the erection of an addition to its plant.

The Manhattan Silk Company, New York, it is announced, has decided to establish a factory in Buffalo, N. Y.

The Forsberg Spring & Gear Company, Rome, N. Y., whose plant was recently burned, is preparing to rebuild.

The Des Moines Incubator Company is considering the erection of a new factory building in East Des Moines, Iowa

The Phillipsburg (N. J.) Manufacturing Company, grinding mills, has commenced the erection of another building.

It is reported that the Chicago & Northwestern Railroad is contemplating erecting repair shops at Wausau, Wis.

The sawmill of R. J. & B. F. Camp, at White Springs, Fla., was destroyed by fire entailing a loss of about $250,000.

The Cyclone Wire Fence Company, Toronto, has decided to locate in Woodstock, Ont., where a factory will be erected.

The plant of the Minnesota Sugar Company, at St. Louis Park, Minn., was destroyed by fire, entailing a loss of $400,000.

The Passaic Steel Company, of Paterson, N. J., is remodeling its plant, converting its universal mill into a groove mill.

The Passumpsic (Vt.) Fibre Leather Company, whose plant was destroyed some time ago, is rebuilding on a larger scale.

Jansen & Zoeller, contractors, Pekin, Ill., are erecting a building in which will be located a cement building block concern.

The Bannockburn Manufacturing Company, Portland, Ore., will rebuild its woolen mill at Albany, Ore., recently destroyed by fire.

Gade Bros., manufacturers of air cooling gasoline engines, plan the removal of their plant from Iowa Falls to Des Moines, Ia.

The J. P. Wilhelm Packing Company, rerecently organized, will erect a plant adjoining the Union Stock Yards, in West Toledo, O

Application for an electric light franchise has been made by the Wilmington (Del.) Electric Light & Power Company, a new concern

H W. Caldwell & Son Company, Chicago, Ill., conveying machinery, etc., is making an extensive addition to its plant, to cost $50,000.

John E. Burchell and others, of Sydney, C. B., have formed the Canada Wire & Nail Company, Ltd., with a capital stock of $200,000.

The plant of the Springfield (Ill.) Boiler Manufacturing Company was burned; loss, about $300,000. The works will be rebuilt at once.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., maker of electric supplies, will build a $10,000 addition to its plant.

The Oriental Emery Company, whose factory at Derby, Conn., was burned some time ago, has leased a factory in New Haven, Conn.

The Union Hardware Company, Torrington, Conn., is having new buildings erected, one of which is to be a power-house and another a forge shop.

The New England Enameling Company, Middletown, Conn., will put up an addition to be used in connection with its galvanizing department.

It is reported that a representative of the St. Louis (Mo.) Car Company is in Buenos Ayres with the intention of establishing shops in that city.

John R. Wiggins & Co., Philadelphia, Pa., have been given the contract for erecting a briquetting plant for the United Gas Improvement Company.

It is stated that the West Ware Paper Company, Ware, Mass., whose plant was recently burned, is preparing plans to rebuild on a larger scale.

The Greek-American Candy Company, of Williamsburg, N. Y., will erect a $150,000 plant in Jersey City, which will include a large power-house.

The North American Manufacturing Company, owners of the town of Newell, W. Va., will erect a million-dollar plant there for the manufacture of pottery.

The Lovell Manufacturing Company, New Haven, Conn., a new concern, with a capital of $200,000, which will manufacture steel wire chain, is looking for a site.

It is reported that Stone & Webster, Boston, Mass., who control the Columbus (Ga.) Railroad Company and several water powers, will soon erect an additional power plant.

It is reported that the Montello Brick Company, Reading, Pa., is planning to build a large plant in or near Pittsburg. The company is now putting up a plant in the Catskills, N. Y.

Crosby & Co., Detroit, Mich., recently incorporated, with a capital of $100,000, to manufacture a stove polish, will erect a factory. Chas. F. Crosby, of Detroit, is one of the incorporators.

The Lidgerwood Manufacturing Company, of Brooklyn, N. Y., manufacturing hoisting engines, boilers, etc., has decided that it will remove its plant to Newark, N. J., which plant, it is said, will cost over $2,000,000.

In our issue of May 4, at page 613, we published an item to the effect that the Main Belting Company, Philadelphia, Pa., was having plans prepared for a new factory. We are since informed that this is an error, resulting from the fact that the company took out a permit to demolish an old building on a part of its property.

New Catalogs.

Roos & Mill, Cincinnati, O. Circular No. IV, illustrating and describing improved plain radial drill. 6x9, pp. 4, paper.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 63, illustrating and describing generating sets. 7x9½, pp. 7, paper.

W. H. Nicholson & Co., Wilkesbarre, Pa. Booklet describing new patent compression shaft coupling. Illustrated. 3½x6, pp. 11, paper.

The Kilborn & Bishop Company, New Haven, Conn. Catalog No. 4 of drop forgings and forged hardware. Illustrated. 6x9, pp. 27, paper.

Oswego Machine Works, Oswego, N. Y. Circular describing 33-inch combination Brown & Carver cutting machine. Illustrated. 6x9, pp. 4, paper.

Lincoln-Williams Twist Drill Company, Tauuton, Mass. Catalog of high-speed and carbon steel twist drills. Illustrated. 6x9, pp. 20, paper.

Colburn Machine Tool Company, Franklin, Pa. Bulletin No. 21, describing new 30-inch vertical boring and turning mill. Illustrated. 6x9, pp. 3, paper.

Holt Manufacturing Company, Stockton, Cal. Bulletin No. TE-19, March, 1905, illustrating and describing traction engines. 6½x10, pp. 16, paper.

Cutler-Hammer Clutch Company, Milwaukee, Wis. Catalog describing magnetic accelerators and couplings. Illustrations and tables. 6x9, pp. 14, paper.

American Forged Steel Flange Company, 64 Wabash avenue, Chicago, Ill. Circular describing forged steel flanges for high-pressure work. Illustrated. 6x8½, pp. 4, paper.

American Pressed Steel Company, 422 Arcade Building, Philadelphia, Pa. Booklet describing the Pearl square auger and mortising machine. Illustrated. 3½x6, pp. 7, paper.

Electric Machinery Company, Minneapolis, Minn. Bulletin No. 56, describing revolving field alternating-current generators and rotary converters. Illustrated. 8x11, pp. 7, paper.

Clement Restein & Co., Philadelphia, Pa. Booklet "A," describing "Belmont" ring, spiral and coil packing, and Booklet "B," describing "Belmont" flax, gum core, standard and diagonal packing.

Canadian General Electric Company, Ltd., Toronto, Ont. Bulletin No. 836, illustrating and describing singe-phase Thomson Type I induction meter for house service. 8x10½, pp. 11, paper.

Walworth Manufacturing Company, 128 Federal street, Boston, Mass. Catalog of pipe tools, including pipe wrenches, pipe cutters, pipe dies, etc. Illustrated. 3½x6½, pp. 37, paper.

J. E. Snyder & Son, Worcester, Mass. 1905 catalog of vertical drilling machines. This is printed on good coated paper, contains numerous illustrations and testimonials from users. 6x9, pp. 64, paper.

G. & H. Barnett Company (Black Diamond File Works), Philadelphia, Pa. 1905 catalog of files and rasps. This is printed on fine coated paper and contains numerous illustrations. 5½x6½, pp. 46, paper.

P. Blaisdell & Co., Worcester, Mass. 1905 catalog of machine tools, including lathes, drills, crank planers, etc. This is printed on fine coated paper and contains excellent half-tone illustrations. 6x9, pp. 70, paper.

Fay & Scott, Dexter, Maine. 1905 catalog describing patternmakers' lathes. This is printed on fine coated paper and contains excellent half-tone illustrations, specifications and telegraph code. 6x9, pp. 32, paper.

The Ingersoll-Sergeant Drill Company (pneumatic tool department), 26 Cortlandt street, New York. Bulletin No. 2001 describing the "Little Jap" drill for use in rock excavation. Illustrated. 6x9, pp. 20, paper.

Consolidated Engine Stop Company, 100 Broadway, New York. Booklet telling about the Monarch engine-stop and speed limit system. This is illustrated and contains a partial list of installations. 4x9, pp. 23, paper.

Cincinnati Planer Company, Brighton Station, Cincinnati, O. 1905 catalog of variable-speed planers. This contains very fine half-tone illustrations of the various types of planers and a list of users. 6x9, pp. 49, paper.

American Injector Company, Detroit, Mich. 1905 catalog of automatic injectors, ejectors, jet pumps, fire plugs, grease cups, etc. This contains tables and some practical questions and answers. Illustrated. 3½x6, pp. 70, paper.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 46 describing and illustrating some late developments in direct-current generators and showing their application to various machines. 7x10, pp. 32, paper.

Parsell & Weed, 129-131 West Thirty-first street, New York. Bulletin 9051, describing Brocksmith dynamo castings and complete experimental outfits, including dynamo, motor, dynamotor, motor-generator, etc. Illustrated. 6x9, pp. 24, paper.

B. F. Barnes Company, Rockford, Ill. 1905 catalog, entitled "Twentieth Century Machine Tools." This contains descriptions, illustrations and specifications of drills, lathes and water tool grinders, also telegraph and cable code. 5½x8½, pp. 74, paper.

American Woven Leather Belting Company, Fuller Building, Springfield, Mass. Catalog describing woven leather belt, which the company has acquired the exclusive right to manufacture in the United States. Illustrated. 6x9, pp. 31, paper.

Goodson Electric Ignition Company, 94 Point street, Providence, R. I. Booklet entitled "Points to Be Considered in Selecting an Igniter," which gives information about the igniter made by this company. Illustrated. 3½x6, pp. 16, paper.

Rolfe Electric Company, Rochester, N. Y. Booklet entitled "Electric Laws; Rules of Practice." This contains useful information for electricians or those interested and also list of articles made by this company, including Schwarz universal bells, buzzers, fuse boxes, etc. Illustrated. 3½x6, pp. 34, paper.

The Simplex Manufacturing Company, 140 Nassau street, New York and Hartford, Conn. Booklet entitled "Devices to Meet the Demand," and which describes the combination bench-filer and hack-saw, safety valve, automatic envelope sealer and postage stamp stripper made by this company. Illustrated. 5½x7, pp. 16, paper.

Electro-Dynamic Company, Bayonne, N. J. Circular No. 7-A, Series "B," giving price list of C. & H. "Compound" non-reversible starting and regulating rheostats. Circular No. 11, Series "B," illustrating and describing types "S" and "L" constant-speed motors and generators. Circular No. 12, Series "B," superseding No. 4 and describing interpole variable-speed motor.

The Westinghouse Companies' Publishing Department, Pittsburg, Pa., has sent us advance copy of a publication which it is preparing for distribution at the International Railway Congress at Washington. This is a very pretty book telling about the Westinghouse Companies in the railway and industrial fields, and containing very fine half-tone illustrations, among them a picture of George Westinghouse. 7½x10, pp. 67, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Turret lathe work, light machinery, tools, models, etc. Metal Novelty Co., Elgin, Ill.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Machinist Table—Standard steam, gas and water pipe tapping sizes; 5c., stamps. E. E. Meyer, Allegheny, Pa.

Automatic machines, construction and designs; undertake manufacturing; experimental. 568 West Broadway, New York.

Wanted—Grinder for horizontal surfaces, 6x24 in.; must be in good condition and a bargain. Box L, Station B, Cincinnati, Ohio.

Draftsman desires to do mechanical designing or general drafting work at home, after office hours, in New York. Address W., care AMERICAN MACHINIST.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Dies, jigs and fixtures; tools designed for special work; manufacturer of clockwork specialties and intricate mechanical instruments. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—Canadian right to build machine of established reputation; plant and equipment the very best for 500 men. Address "Business," Box 99, AMERICAN MACHINIST.

W. H. Chappell, the best machine shop organizer, manager, critic and cost-cutter in America, solicits correspondence regarding temporary engagements. Box 57, AM. M.

For Sale.

For Sale—AMERICAN MACHINIST, 1884 to 1902. For particulars address J. E., care A. M.

For Sale—U. S. patent rights for small machine of established reputation; demand great enough to keep large factory now running night and day. For particulars apply to Box 98, AMERICAN MACHINIST.

For Sale—Patent issued 1900, automatic lock for dumbwaiters, hoists, elevators, etc.; have sold over 3,000; able man could clear $5,000 to $15,000 yearly; manufacturers and mechanics with capital should investigate; low price. Address "Patent," AMER. MACH.

Owing to the death of Mr. Robert Cowley, for many years senior member of the firm of Riley & Cowley, of South Brooklyn, N. Y., marine and general machinery builders, the entire equipment of the shops owned and operated by this well-known firm will be sold at private sale. Examination can be made between 8 A. M. to 4 P. M. The shops consist of the following: Machine shop, blacksmith shop, pattern shop, besides office equipment and storehouse, and are located at Richard and Bowne streets, South Brooklyn, N. Y., near Hamilton Ferry.

Business Opportunities.

Mechanical engineer, with long, practical experience, wishes associate to form an engineering company on equal-amount basis; mechanic preferred. Box 144, AMER. MACH.

Satisfaction Guaranteed.—We build special machinery, machine parts, interchangeable machinery, punches and dies; gear cutting, etc. The John R. Williams Co. Machine Works, 114-116 Liberty St., New York; 120-126 Pacific St., Newark, N. J.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

A1 metal patternmaker of 10 years' experience on hand, and molding machine patterns, wants a position. Box 149, A. M.

ENGLAND.

Two young draftsmen (English) desire situation anywhere in Canada; well up in pressure and suction gas plant design, pneumatic and general; sound technical training. Box 135, AMERICAN MACHINIST.

INDIANA.

Technical graduate, 4 years' experience with gas and gasoline engines, wants position in drafting room or in the shop. Box 119, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 148, care AMERICAN MACHINIST.

An expert designer of electric and hydraulically operated valves is open for a position. Box 150, AMERICAN MACHINIST.

Man with long experience on duplicate work and tools for the same wants position as superintendent or general foreman. Box 147, AMERICAN MACHINIST.

Wish to represent a good steel or brass mill for New England; commission basis preferred, I to pay my own expenses; have had extensive experience in metal line, both in manufacturing and on road; can give best of references from manufacturers throughout New England. Box 140, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—By young man of experience, position as superintendent (or assistant) of factory manufacturing small or medium sized machinery; technical graduate; East preferred. Box 145, AMERICAN MACHINIST.

NEW YORK.

Mechanical superintendent desires position; expert on kerosene oil engines. Box 143, A. M.

Machinist; thorough mechanic; all-around experience on small work; references. Box 134, AMERICAN MACHINIST.

First-class mechanic; experience on automatic machines, punch, die and tool work, small experimental work. Box 133, AM. M.

General machinist on engines, new, and repairs; understand gas and oil engine construction; can design smaller sizes of the latter. Box 107, AMERICAN MACHINIST.

Situation as expert designer of tools, jigs and fixtures, together with making and application of same; is open to consider a new position in this line. Box 141, AMER. MACHINIST.

Position is desired by an expert in the manufacture of accurate interchangeable machinery, to take full charge of the designing of labor-saving tools and the manufacturing of product. Box 142, AMERICAN MACHINIST.

Mechanical engineer, gas engine expert, extensive experience in designing, testing and building of internal combustion engines, able to introduce gas engine building, wants position as chief engineer or superintendent, eventual representative. Box 124, AMER. MACH.

OHIO.

Superintendent of tool works seeks wider field of operation and solicits correspondence with parties in or near New York city. Address Box 108, AMERICAN MACHINIST.

PENNSYLVANIA.

Broadly qualified superintendent and master mechanic desires change; technical education; drop forge, press work, track tools; 18 years in machine shop and drawing room. Box 118, AMERICAN MACHINIST.

Foreman—Toolroom or shop; hustling inventive young man; wide experience on tools, metal stamping, general machinery; modern systems and methods, designer, labor and time savers; vicinity New York or Phila. Box 146, AMERICAN MACHINIST.

VERMONT.

Mechanical draftsman wants engagement; 8 years' practical experience on valves and fittings for gas, water, steam; special hydraulic machinery for water works filtration; references. J. H., AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Superintendent of engine and general machine shop desires position; traveling salesman, superintendent or foreman; wide practical experience; designer of tools, jigs and special machinery. Address Box 122, A. M.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers. Apply to Ross Rifle Co., Quebec, Canada.

Wanted—First-class draftsmen on tool and gauge work. Apply Ross Rifle Co., Quebec, Canada.

CONNECTICUT.

Wanted—Good all-around machinists on engine and general machine work; good pay and steady work. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

Wanted—A modern, up-to-date general foreman of experience and ability, to handle about 50 men; no application considered by men out of work. Address "Motor," care AM. MACH.

GEORGIA.

Wanted—Man to take charge of toolroom; must be capable of installing system; have ideas as to tools, jigs and templets and be good mechanic; state age, class of work familiar with, present connection and wages wanted. "Progress," care AMERICAN MACHINIST.

ILLINOIS.

Two draftsmen with electrical and mechanical experience, by Chicago company; state age, education, past employers and salary expected. Box 128, AMERICAN MACHINIST.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

A thoroughly competent factory superintendent is wanted by a Chicago company manufacturing small machines; must be up on shop economies, possess executive ability and be able to get out goods; no attention will be paid to answers that do not state name, age, experience, salary wanted and give references. Box 115, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MASSACHUSETTS.

Foreman; 5 to 10 years' experience on punch press work; $30 per week. Write Y. M. C. A., Employment Department, Springfield, Mass.

Wanted—Young man with at least slight knowledge of the theory of gears, for office work, by gear jobbing firm; state age and experience; references required. Address Box 138, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Thoroughly competent toolmaker as foreman of tool department in large brass factory, manufacturing valves, engine trimmings, etc.; only first-class man wanted; state experience and salary desired. Box 136, A. M.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern and up-to-date methods. To honest, competent men who will "do things" steady work and first-class wages are waiting. State experience, age, references and full information. Cadillac Automobile Company, Detroit, Mich.

NEW JERSEY.

Wanted—A competent mechanical draftsman for work on condensers, pumps, etc.; location near New York. Address, stating age, experience, etc., Box 114, AMER. MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Draftsman, designer, plenty work, wants partner with ability. Box 137, AMER. MACH.

Wanted—Three good draftsmen with mechanical knowledge to design pumps and hydraulic machinery; technical graduates preferred. Box 106, AMERICAN MACHINIST.

Assistant manager for New England corporation; executive; salary $1,200; other positions on file; send for list and particulars; outline your experience. Business Opportunity Co., 1 Union Square, New York.

OHIO.

Wanted—Floor and machine hands; good wages; steady employment. Brown-Cochran Co., Globe st., Lorain, Ohio.

PENNSYLVANIA.

Machine and floor hands, familiar with machine tool work. Standard Engineering Works, Ellwood City, Pa.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Several first-class instrument makers. Apply in person or by letter to Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—One diemaker and one toolmaker; only first-class workman need apply; state experience and wages expected. Address Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Experienced draftsmen in electrical apparatus, switchboards, motors and generators; only first-class men need apply; state experience and salary expected. Address Box 102, AMERICAN MACHINIST.

Wanted—Machinist to assemble engines by contract, also one to do machine work, or one man to do both; only men with experience need apply; chance for hustling man who knows how to do high-class work to make big money. Box 100, AMERICAN MACHINIST.

TEXAS.

Wanted—Superintendent for our machine shop, working about 30 men now, but expect to enlarge shortly; our work is general repairs on sawmill, cotton oil mill and sugar machinery engines, locomotives, marine engines and pumps; we also build new rotary pumps and other machines on orders; have no special machine line that we manufacture; our general foundry is well equipped and under capable management; must be competent to make estimates on all work, a handler of men—in fact, a first-class man. Address, with full particulars as to former work, salary, etc., Dickson Car Wheel Co., Houston, Texas.

WEST OF MISSISSIPPI.

Wanted—A strictly first-class machinist as foreman of a small machine shop; must be capable of handling the entire business connected with the shop; a good position for the right man. Address "Iowa," care AM. MACH.

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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

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Boston Gear Works, Boston, Mass.

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Massey Mach. Co., Watertown, N. Y.
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
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Clark Cast Steel Cement Co., Shelton, Conn.

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Pratt & Whitney Co., Hartford, Conn.

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"Whitney" Hand (Feed) Milling Machine

used in preference to all others by U. S. Government, Western Electric Co., Underwood Typewriter Co., Smith & Wesson, Hopkins & Allen Arms Co., Standard Adding Machine Co., Smith Typewriter Co., leading Automobile Manufacturers, etc., etc.? Possibly it is because we make more of a specialty of Hand Millers than any other company in the world, and give our customers greater return for their investment by way of quality, quantity, range and efficiency.

PITCH	DIAMETER OF ROLL
1 in.	$\frac{5}{8}$ in.
$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.
$1\frac{1}{2}$ in.	$\frac{7}{8}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These Are **"WHITNEY" STANDARDS** For ROLLER CHAINS

The Pitch Sizes and Diameters

advance uniformly in perfect proportion. They have Broken all Records for Efficiency, and have been adopted for most of the leading American Cars, including

"Acme" "Auto-Car Equipment" "Baker" "Bramwell" "Cadillac" "Columbia" "Corbin" "Champion" "Elwell-Parker" "Ford" "Franklin" "Grout" "Gaeth" "Gibbs" "Hartford Motor Street Sweeper" "Knox" "Lenawee" "Mitchell" "Moline" "Matheson" "Milwaukee Four-Wheel Drive" "Manhattan" "Olds" "Pope-Hartford" "Pierce-Racine" "Prescott" "Queen" "Rambler" "Stearns" "Sommer" "Snell" "Thomas 50 and 60 H.P." "Tourist" "Wayne" "Western-Electric."

PITCH	DIAMETER OF ROLL
1 in.	$\frac{9}{16}$ in.
$1\frac{1}{4}$ in.	$\frac{5}{8}$ in.
$1\frac{1}{2}$ in.	$\frac{3}{4}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These are the Old or Competing Standards

The **PITCH SIZES** advance uniformly, but the **DIAMETERS** are irregular and not in perfect proportion.

All chain manufacturers have adopted "Whitney" Standards for the new sizes $1\frac{3}{4}$ in. and 2 in. Pitch.

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Patterson, Gottfried & Hunter, Ltd., New York.

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Lane Mfg. Co., Montpelier, Vt.
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Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

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Underwood & Co., H. B., Philadelphia, Pa.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
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Stevens, F. B., Detroit, Mich.

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Warner Instrument Co., Beloit, Wis.

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Boker & Co., Hermann, New York.
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Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
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Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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Osgood, J. L., Brooklyn, N. Y.
Steel Set Diamond Co., New York.

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Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Perkins Mach. Co., Warren, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
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Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
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Dallett Co., Thos. H., Phila., Pa.
Flather Planer Co., Mark, Nashua, N. H.

Drilling Machines, Multiple Spindle—*Continued*
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co.. Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roos & Mill, Cincinnati, O.
Vandyck Churchill Co.. New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P.. Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co.. Cincinnati, O.
Dallett Co., Thos. H.. Phila., Pa.
Davis Mach. Co., W. F., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark. N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co.. R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Valentine Gas Engine Co., Plainfield, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

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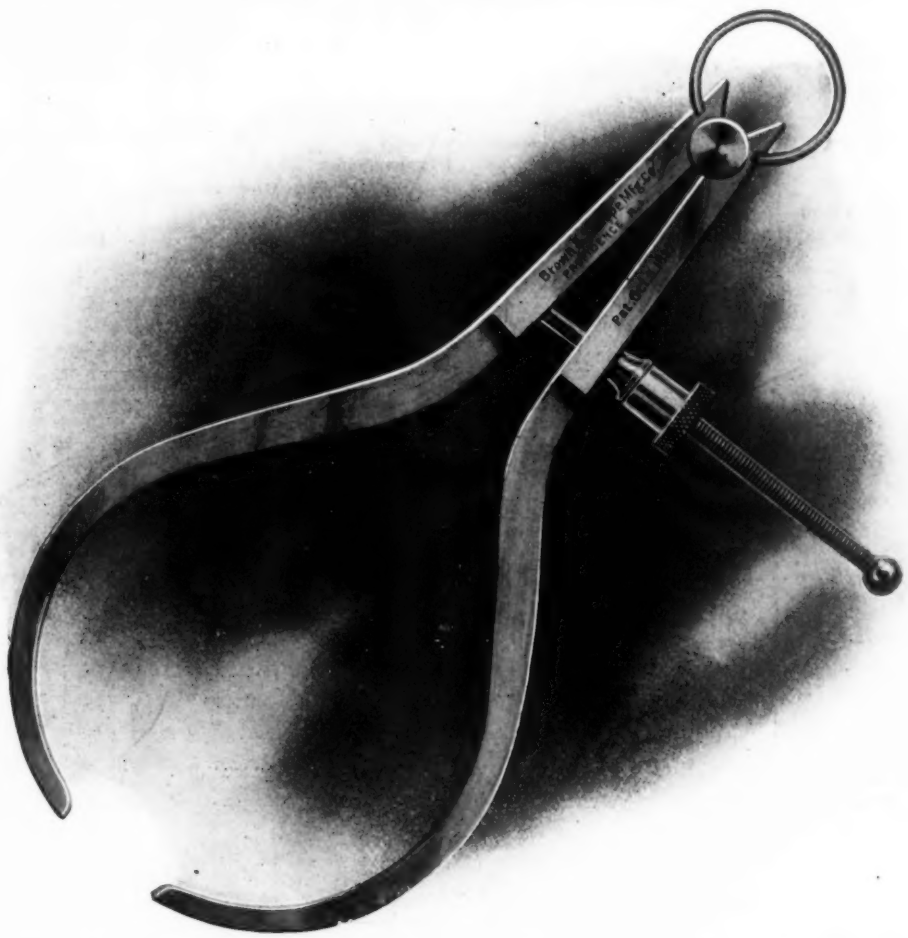

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AND ARE RECOGNIZED AS

STANDARDS FOR ACCURACY.

THEY ARE CARRIED IN STOCK BY LEADING HARDWARE DEALERS AND SOLD AT PRICES THAT ARE RIGHT.

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Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
American Elec. & Controller Co., New York.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineer, Consulting, and Architect
Thompson, Hugh L., Waterbury, Conn.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Filters, Oil
Houghton & Co., E. F., Philadelphia, Pa.

Fittings, Brass
Nolte Brass Co., Springfield, O.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Erie Forge Co., Erie, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J
Grant Gear Works, Boston, Mass
Harrington, Son & Co., Edwin Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

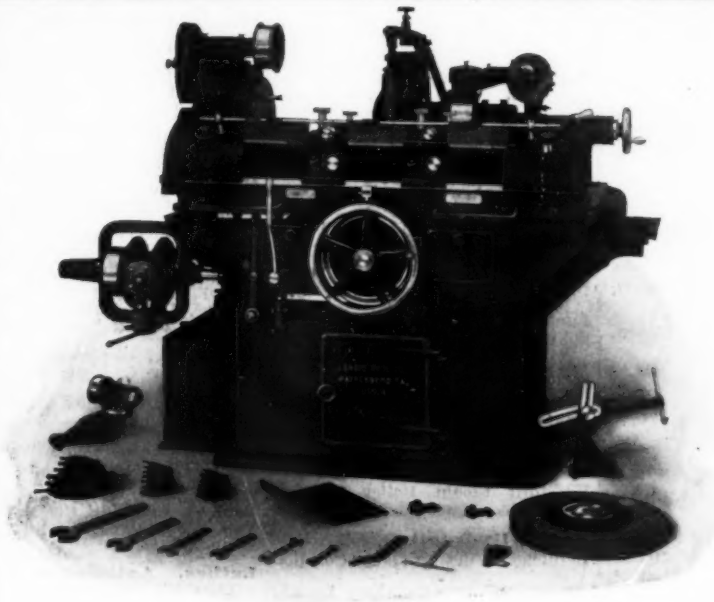
Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Kingston, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.



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12" Swing. 42" Between Centers.

WE are not giving away anything except information—we're extremely liberal with that. But some of you are slow in asking for it. That's strange in view of the fact that the information we are ready to give is relative to a line of Grinding Machines which in variety and general excellence surpasses any to be found in America or abroad.

It was the Landis Grinders that **Revolutionized Grinding Methods,** that put grinding on a par with other high-speed operations of the times, that proved the possibility of grinding to within .0001" of absolute accuracy.

The picture shows the No. 23 Plain Grinder, a little newer than most and possibly a little better.

You wish information about—well, just tell us the nature of your grinding work and we'll give you information about the right one.

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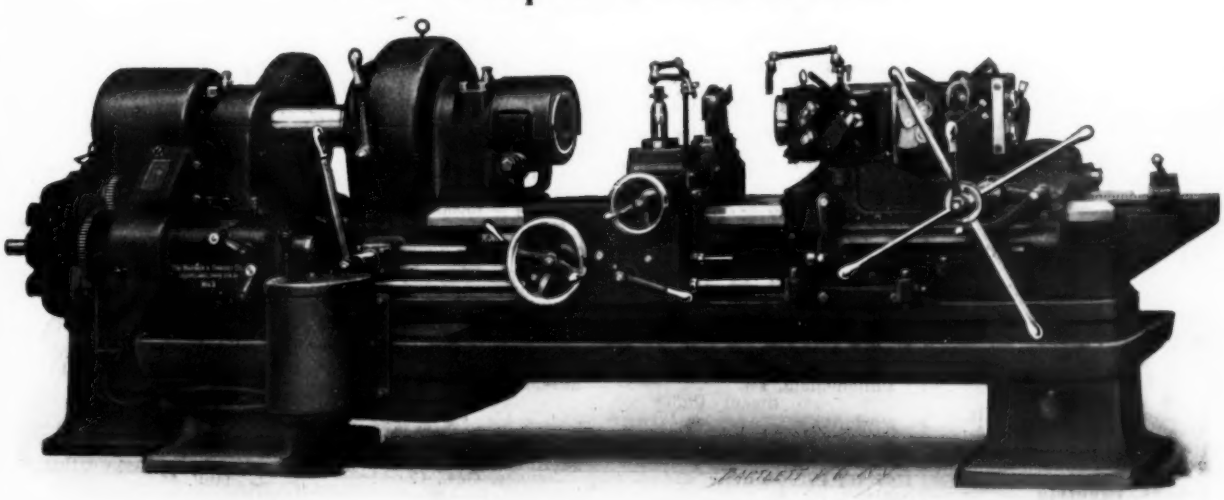

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The Warner & Swasey Co., Cleveland, Ohio, U. S. A.

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Grinding and Polishing Machines

Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
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Hack Saw Blades and Frames

Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power

Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric

Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Hammers, Drop—*Continued*

Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power

Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Schacht Mfg. Co., Cincinnati, O.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.

Heaters, Feed Water

Sturtevant Co., B. F., Hyde Park.

Heating and Ventilating Apparatus

Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines

Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery

Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Hoist, Mfg. & Const. Co., Philadelphia, Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric

C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed

Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Steam

American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests

Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters

Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc

General Electric Co., N. Y. City.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

General Electric Co., New York.
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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Bradford Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

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Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes

Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.

Lathes—*Continued*

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Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepherd Lathe Co., Cincin., O.
Springfied Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench

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Blount Co. J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Niles-Bement-Pond Co., New York.

Lathes, Brass

Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood

Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern

Butler, A. G., N. Y. City.

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Merritt & Co., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.

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Lunkenheimer Co., Cincinnati, O.

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Fairbanks Co., New York.
Garvin Mach. Co., New York.
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McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicgao, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
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Built better than modern tool steel calls for.
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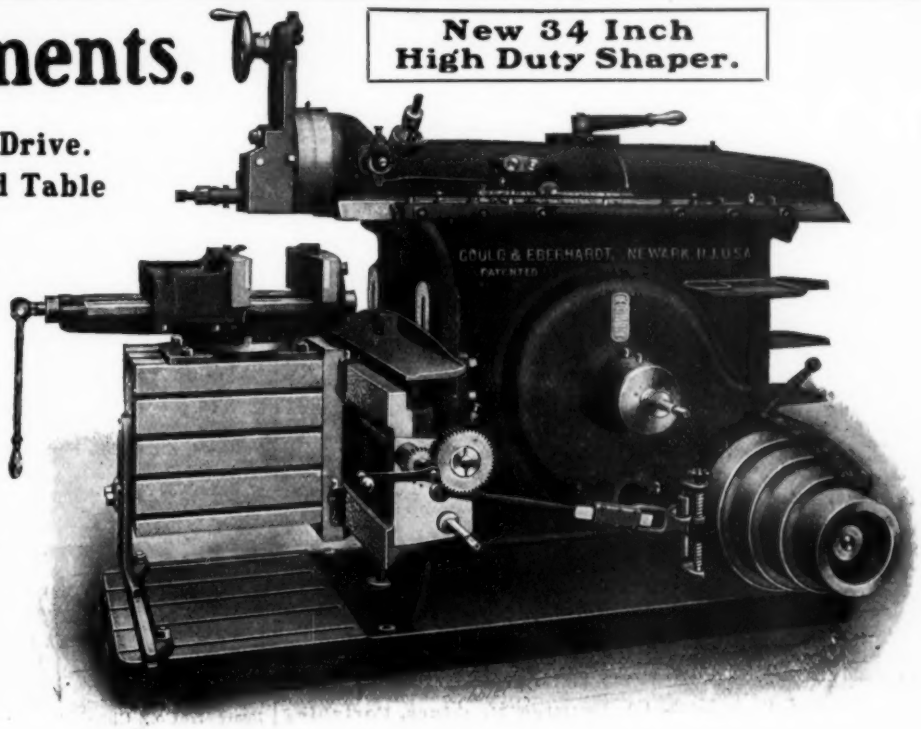
Automatic Gear Cutting Machines and Accessories, Shapers, Drill Presses.



Gould & Eberhardt, Newark, N. J., U. S. A.

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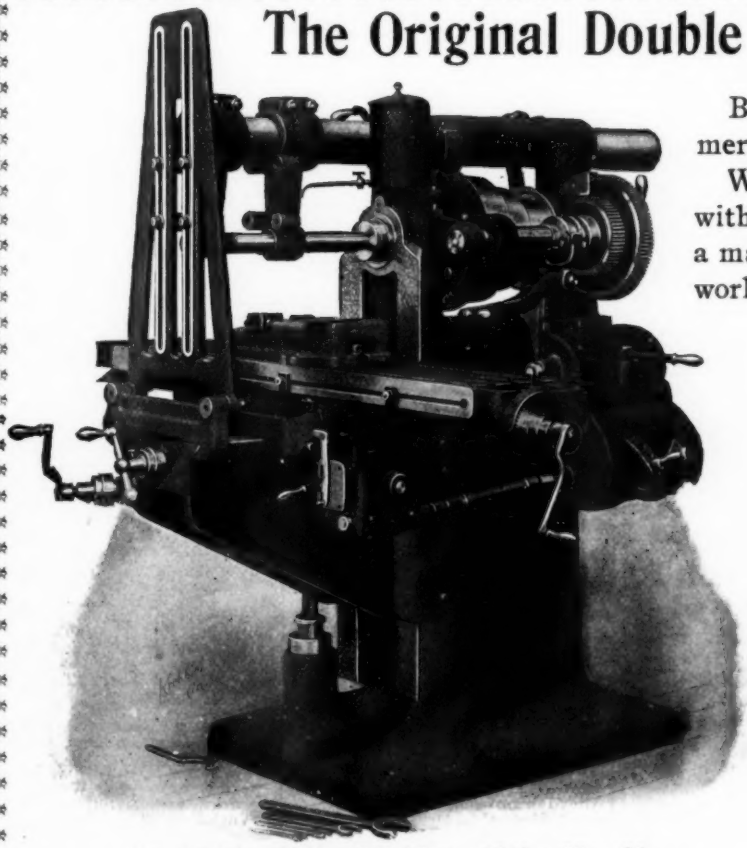
The Original Double Back-Geared Miller.



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Beware of imitations and "hot air" merchants.

When you want a reliable machine without complicated feed mechanism—a machine that will do more and better work than any other—buy a "LeBlond Double Friction Back-Gear Miller."

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Pratt & Whitney Co., Hartford, Conn.
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Nicholson & Co., W. H., Wilkesbarre, Pa.

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Cincinnati Milling Mach. Co., Cincinnati, O.
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Hartford Mach. Screw Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Whitney Mfg. Co., Hartford, Ct.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.

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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
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Newton Mch. Tool Works, Philadelphia, Pa.
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Quint, A. D., Hartford, Conn.
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Vandyck Churchill Co., New York.

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Crocker-Wheeler Co., Ampere, N. J.

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National Elec. Co., Milwaukee, Wis.
Northern Electrical Mfg. Co., Madison, Wis.
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Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
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Houghton & Co., E. F., Philadelphia, Pa.
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Oilers
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Oil Stones
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Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

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Hill, Louis A., Washington, D. C.
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Straley & Hasbrouck, New York.

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Blount Co., J. G., Everett, Mass
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Prentiss Tool & Supply Co., New York.
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Curtis & Curtis Co., Bridgeport, Conn.
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Standard Tool Co., Cleveland, O.

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Fairbanks Co., New York.
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Garvin Mach. Co., New York.
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Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
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Woodward & Powell Planer Co., Worcester, Mass.

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Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
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Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

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Faneuil Watch Tool Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

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Perkins Mach. Co., Warren, Mass.
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Chambersburg Engineering Co., Chambersburg, Pa.

Presses, Hand
Perkins Mach. Co., Warren, Mass.

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Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson-Stillman Co., New York.

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Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
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Niles-Bement-Pond Co., New York.
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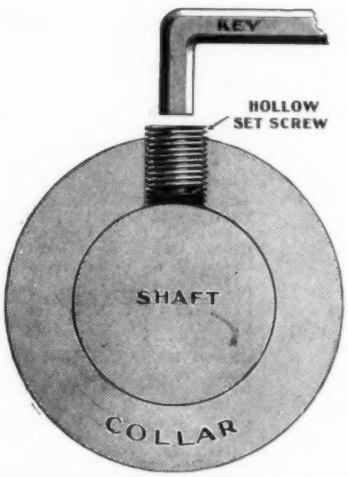
The New Hollow Set Screws Eliminate Danger

U. S. Patent
679,927



THE New Hollow Screws have no projections—you screw them down well within the collar. No shoulders; no countersinking; no protectors and hubs necessary. That means a saving in cost and labor; eliminates all danger of accident.

They are made of steel, drawn with a hexagonal hole, which insures elasticity and prevents loosening during changes of temperature. With the wrench shown in illustration, the screw can be tightened or removed with ease, and there is no worn, battered screw slots or twisting off of heads to contend with. You get a bearing with the wrench the entire length of the screw, and force is applied largely at the point of the screw, where it is required.

WITH the Hollow Set Screws one length of each size is all that is required for any depth of hole, and thus by eliminating sizes they are much cheaper in the aggregate than the old style screws.

Short screws do not lose lead of thread as do long ones. By putting two screws in a hole they are locked and the thread strain is equalized.

Deep holes need be threaded at bottom only.

Hollow Screws can be sealed against rust and wet by filling the hole with wax or oil.

Hollow Set Screws have passed the experimental stage. Several hundreds of firms have tested them and found them advantageous in a great many ways.

Send for Circular No. 1644 and Samples.

MADE IN FOUR DIAMETERS ONLY AS FOLLOWS. U. S. STD. THREAD. CUP POINT.

Diameter	Thread	Length	How Packed
⅜-inch	16	⅜-inch	100 in box
½-inch	12 and 13	⅝-inch	100 in box
⅝-inch	11	1-inch	50 in box
¾-inch	10	⅞-inch	50 in box

Hammacher, Schlemmer & Co.

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Watson-Stillman Co., New York.

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Hammacher, Schlemmer & Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Electric Controller & Supply Co., Cleveland, O.
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Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
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Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

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Allen, John F., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.

Rock Drills, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Athol Machine Co., Athol, Mass.
Hammacher, Schlemmer & Co., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Rust Preventative
Houghton & Co., E. F., Philadelphia, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing and Sifting Machines
Gould & Eberhardt, Newark, N. J.
Obermayer Co., S., Cincin., O.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Mich. Agricultural College, Agricultural College P. O., Mich.
Michigan College of Mines, Houghton, Mich.
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co. Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co. New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Reece Co., E. F., Greenfield, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russel Mfg. Co., Greenfield, Mass.

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry Co., Pittsburg, Pa.
Baush Mchry. & Supply Co., Springfield, Mass.
Chandler & Farquhar, Boston, Mass.
Columbia Steel Co., Elyria, O.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.

Second Hand Machinery
Continued
Motch & Merryweather Co., Cleveland, O.
New Era Gas Engine Co., Dayton, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Burlin, Chas. T., Whitinsville, Mass.
Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
National Separator & Mach. Co., Concord, N. H.
Nicholson & Co., W. H., Wilkesbarre, Pa.

Shafting
Brightman Mfg. Co., Shelby O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Pryibil, P., New York.
Union Drawn Steel Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Shepherd Lathe Co., Cincin., O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Churchill Co., New York.

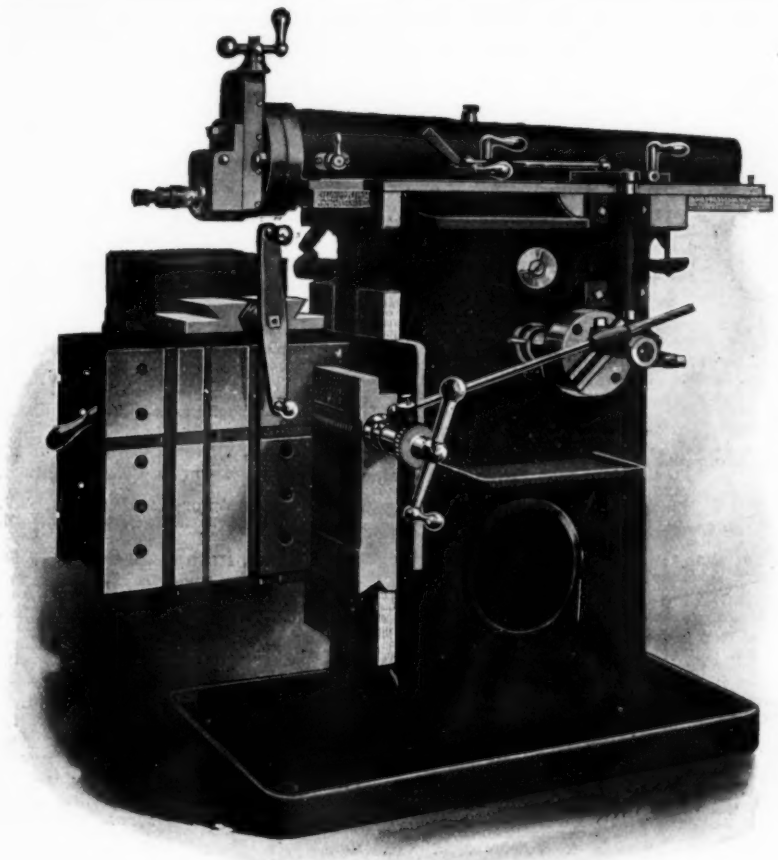
Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., Warren, Mass.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Slotters
Baker Bros., Toledo, O.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.



Hendey 15″ Tool Room Shaper, Re-Designed and Improved

Has heavier Cross-head. Dial reading to Thousandths on Cross-feed Screw.

Taper Gib between Cross-rail and Saddle with Adjustment at Both Ends.

Safety Stop for Ram to prevent extreme return when head is down on an angular cut.

It has All the Good Features that this Shaper has Long Been Noted For, but it is now Just a Little Bit Better Than It Ever Was Before.

The Handiest Tool Room Shaper in the Market to-day.

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Torrington, Conn.

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Inasmuch as it costs nothing to know about this machine, we hope to hear from you.

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They are a composite of everything you could desire in a shaper, and as a result have a pleasing way of turning out work profitably. The design and making has been to this end alone. As an instance of convenience there is the swiveling table with tilting head; this allows for the completion of several operations at one setting of the work, which saves time and insures closer accuracy. This single feature will serve to point the value of the many others, all of which have description in special bulletins.

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New Haven Mfg. Co.. New Haven, Conn.
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Niles-Bement-Pond Co., New York.

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Standard Tool Co., Cleveland, O.

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Beaman & Smith Co., Prov., R. I.
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co.. Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mechanics Machine Co., Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland. O

Stampings, Welded
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
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Boker & Co.. Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse Co., Peter A., New York.
Kent & Co., Edwin B., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brightman Mfg. Co., Shelby, O.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros, Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland. O.
Hartford Mach. Screw Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Tuttle Mfg. Co., H. A., South Norwalk, Conn.
Valentine Gas Engine Co., Plainfield, N. J.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Twist Drill Co.. Cleveland, O.
Frasse Co., Peter A., New York.
Geometric Tool Co., New Haven, Conn.
Hammacher. Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reece Co., E. F., Greenfield, Mass.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., has. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardiner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.

Tool Holders —*Continued*
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford. Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co.. Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Machinery Co., New Haven, Conn.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Philips Pressed Steel Pulley Wks., Philadelphia, Pa.
Pryibil, P., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co.. Edwin. Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn. N. Y.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co.. Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence. R. I.
Bullard Mach. Tool Co.. Bridgeport. Conn.
Dreses Mach. Tool Co.. Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madiosn, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co.. Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co.. Hartford. Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co.. New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Mach. Tool Co.. Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Athol Mach. Co., Athol, Mass.
Hammacher, Schlemmer & Co., New York.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co.. Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co.. Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon. Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co.. Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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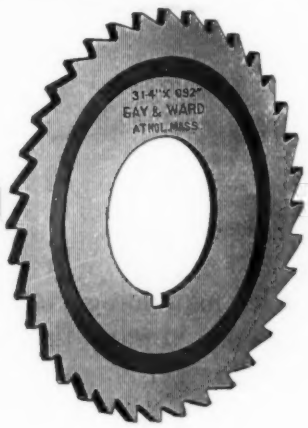
Pratt & Whitney Co., Hartford. Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co.. Hartford. Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co.. Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.



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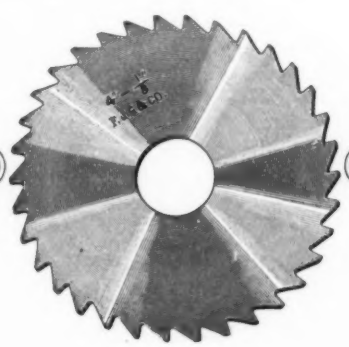

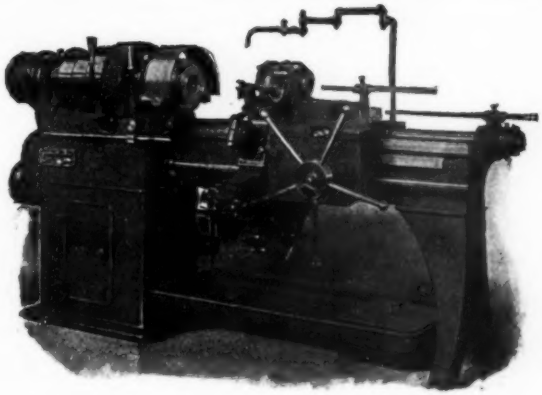

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The construction of turret is the ideal one for accuracy. It revolves on a solid ringway 15″ in diameter at a 45° angle, and is held thereto by a heavy ring gib with mating way at a 45° angle.

The popularity of the tool shows that it is

Perfectly Practical

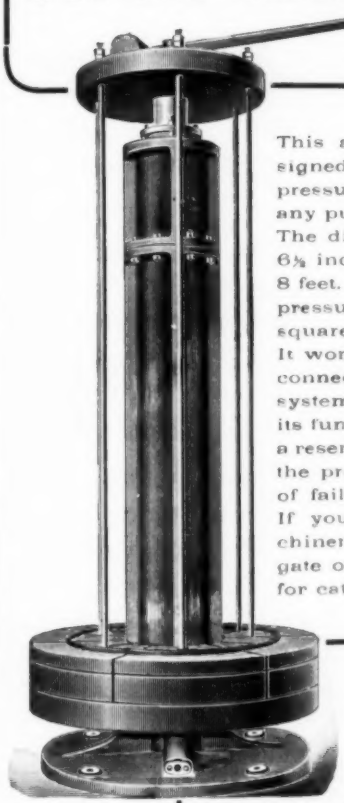
If you are interested, ask for the Catalogue.

Massey Machine Co.

Watertown, N. Y., U.S.A.

The Walter H. Foster Co., General Agts., 114-118 Liberty St., New York.

For the Storage of Pressure



This accumulator was designed for storing, under pressure, oil or water for any purpose.

The diameter of the ram is 6½ inches, and the stroke is 8 feet. It yields a maximum pressure of 275 lbs. per square inch.

It works in very handily in connection with the oiling systems of turbo-generators, its function being to provide a reserve supply of oil under the proper pressure, in case of failure of the oil pump. If you use hydraulic machinery you ought to investigate our line. Write to-day for catalog.

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IT'S team work that wins in football or business—each man doing the thing that he can do best, yet all working as one toward the goal. That's what spells $ucce$$ in any legitimate enterprise.

One man may have brains enough and time enough to captain the team, but no one man can know enough or do enough to do it all and do it right—other men must take care of the details.

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We want to be right up toward the point of the flying wedge that carries your business message and your goods to the consumer in spite of all obstacles. You can boss the job but we want to be in it, for we know the game and can help you win it.

To your business experience and knowledge of your goods, we add the full strength of our knowledge of advertising—not general knowledge of piano, patent medicine and breakfast food advertising, but specific knowledge of your particular class of product, and the kind of talk that attracts and convinces the class of people to whom you must sell it if you sell it at all.

We don't make the same old time-worn plays for everybody—we size up the possibilities and the probalities before we start, talk with you over the vulnerable points in the consumer's armor of doubt, and, when we do start, make every move count for something.

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AMERICAN MACHINIST
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An Interesting Pair of Spiral Intermittent Gears.

Figs. 1 and 2 show a pair of intermittent gears having the peculiar characteristics that, if the large gear be rotated continuously in one direction, the pinion will rotate alternately ¾ of a turn in one direction and ¼ of a turn in the opposite direction, with a rest or dwell between each movement. Similar gears have been made as part of a certain machine, the nature of which we are not at liberty to mention. The angle of spiral of both gears is 45 degrees, and under ordinary conditions either gear could be the driver. The large gear, however, has around portions of its pehiphery two tongues—which are practically a continuation of certain of the teeth. These tongues fit into grooves in the pinion, and during their passage through the grooves lock the pinion at rest. Owing to this feature, the large gear must in this case be the driver.

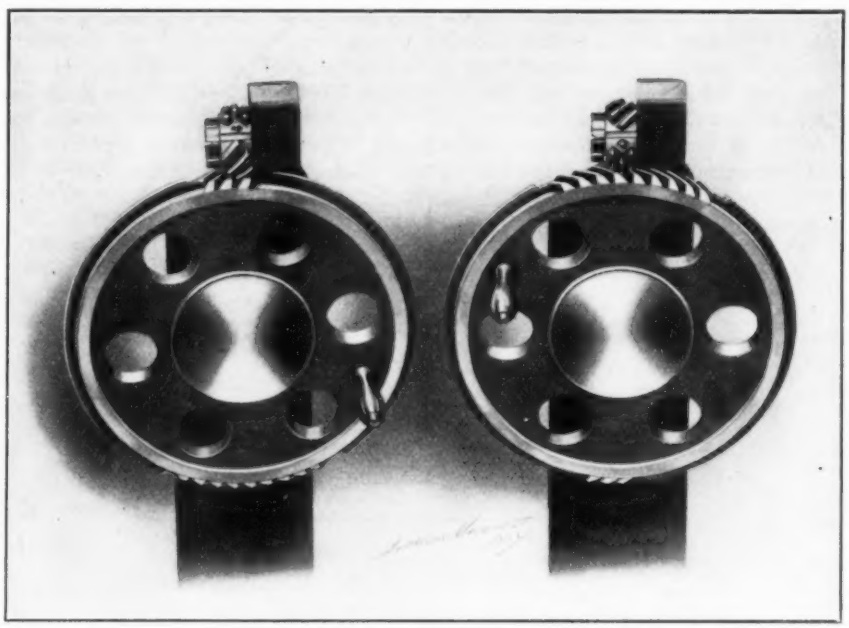


FIG. 1. THE RIGHT-HAND TEETH IN MESH WITH THE "PEG" SEGMENT. FIG. 2. THE LEFT-HAND TEETH IN MESH.

The pinion has twelve teeth, divided into four groups of three teeth each, with one of the before-mentioned slots between each group. Two opposite groups of teeth are cut left hand, the two alternate groups are cut both left and right, leaving the teeth like a series of pegs.

Imagine the handle at a position opposite the pinion, then the left-hand teeth in the large gear will be at the left. There are nine teeth cut in this segment which when the handle is turned—in the direction of the hands of a clock—engage first with the three teeth of a double-cut group on the pinion, then with the three left-hand full teeth of the next group, then with the three teeth of the other double-cut group. The pinion has then turned three-quarters of a revolution. The tongue then engages with the slot in the pinion and the rotation of the pinion is arrested. The large gear turns until the three right-hand teeth on its periphery come into mesh with the double-cut group first referred to, and reverse the direction of rotation of the pinion for a space of three teeth, or one-quarter turn, when the tongue again locks the pinion and the handle reaches the starting position. The large gear has thus made one turn and the pinion has advanced through three groups of three teeth each, equal to three-quarters of a turn, and has reversed through one group of three teeth, or one-quarter turn. Thus the total advance is but two groups of three teeth, or one-half turn, and to bring the gear and pinion into the same relative position as they were at the start the wheel must make another complete turn.

The blank for the large gear was turned to the extreme diameter across the top of tongue, mounted in the milling machine, and the left-hand teeth, which extend clear across the face, were gashed slightly below the level of the top of the tongue. The blank was then indexed one-half way around, from the central left-hand space, the table swung for right hand, and a deep right-hand gash made for locating. Then the blank was indexed half way around from the central right-hand space, the table swung back for left hand, and the left-hand teeth section milled down to the proper gear diameter. Then the full-length left-hand teeth were cut, and also a gash made outside of the end teeth which join the tongue so as to get the curve of the tooth, but not going far enough to touch the tongue. The blank was then indexed back to the right-hand locating space; the table swung, blank milled down to the proper gear diameter, and the right-hand teeth were cut the same as the left-hand. The table was then set square, and an end mill was put into the spindle, and the stock milled away—leaving the tongue. It will be no-

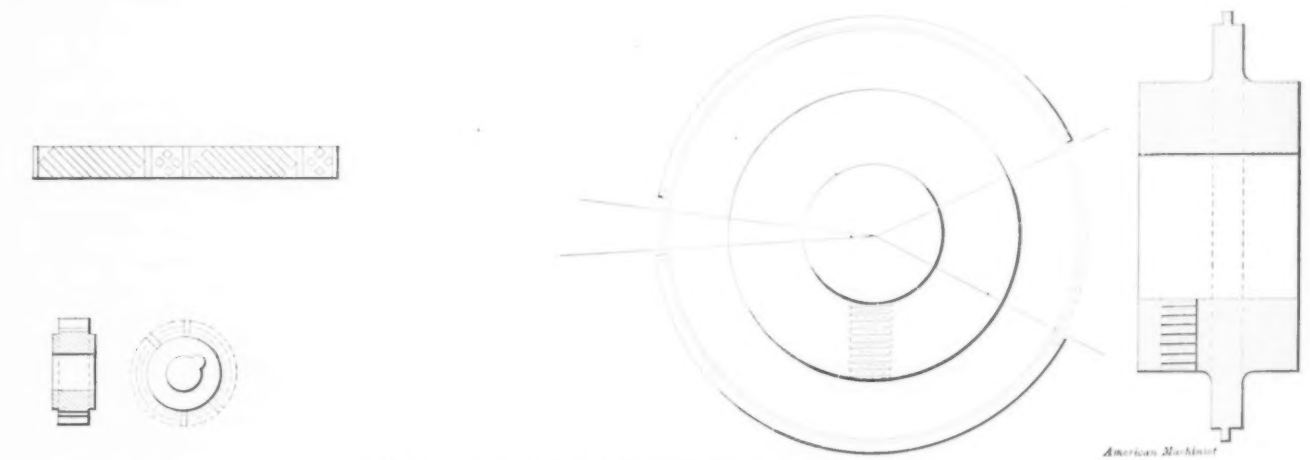


FIG. 3. LAYOUT OF A PAIR OF INTERMITTENT SPIRAL GEARS.

ticed that it was not necessary to remount the blank at all. The outsides of the teeth joining the tongue were chipped out as smooth and true to curve as possible.

An important feature was to get the angle of the end of the tongue just right, and not file it too far back, which would have allowed the large gear to carry the small one somewhat beyond the point where the tongue should enter the slot, thus causing the end of the tongue to strike the side of the small gear and arrest the movement or perhaps cause breakage. The cutting of the small gear was simply a matter of setting the cutter directly over the center of the blank and swinging the table for both hands; the slots were cut as the last machine operation, and then the little sharp projections which were left at the ends of the crosscut sections and near the slots were chipped off, as they were surplus and would interfere with the movement of the gears.

Fig. 3 shows layout of a set of the same style of gearing as Figs. 1 and 2, but of a different ratio.

The gears were cut by the Boston Gear Works, and were prepared preliminary to cutting into more expensive blanks. The work was accomplished by the usual methods, and the finished gearing accomplished the desired results and is now in successful use.

Mounting a Shuttle-Box Pattern on a Molding Machine.

BY JOHN WEAVER.

The necessity for perfect and uniform castings has increased the demand for molding machines, especially in the line of looms and other textile machinery where the castings are supposed to fit without any machine work on them except the drilling of a hole or two with a jig. A shuttle box, such as shown in Fig. 1, mounted on a hand-rammed molding machine, can in a short time pay for the cost of mounting and be a money maker for the foundryman. It is only one of many jobs that are being made on machines daily. There are several ways of mounting patterns and also several styles of machines to mount them on. The method shown in this article is old and reliable and in use in hundreds of foundries throughout the United States.

In mounting a pattern on a molding machine the first thing to determine is the parting line. Always try to make this as straight as possible, as the crookeder the parting line the more expensive it is to mount the pattern. When the parting line has been determined, then the drawing of the pattern from the mold without tearing the sand is the next point. In the method here shown the stripping plate strips the entire outline of the pattern, preventing any tearing in that part of the mold, and all holes or straight parts inside are prevented from tearing by stools (see *F*, Fig. 3). These stools remain stationary while the pattern *A* drops down around them. After the parting line has been determined, if it is very irregular a flat plate like *E* should be made, and also building-up pieces like *B* and *C*, Fig. 4. The patternmaker, when making the pattern for the building-up pieces, can allow for a file finish in addition to the shrink allowance. The parting line on the shuttle-box pattern to be mounted can be seen in Fig. 2 by tracing the top surface of plate *E*, the upper surfaces of building-up pieces *B* and *C*. The parting line on the interior of pattern *A*, on the end where the building-up pieces *B* are placed, is shown in dotted lines running from the lower surface of *O* up to section of pattern marked *P*, then around that edge to *Q*, and from there on around the under side of the shell of the pattern clear on until the end of the pattern is reached, and from there on the parting line is made by building-up pieces *B*. This interior parting line is made by the upper face of the stool *F*, Fig. 2.

To fit this job on a machine such as shown in Fig. 3, have wood patterns made of stripping plate *E*, pattern plate *G* and

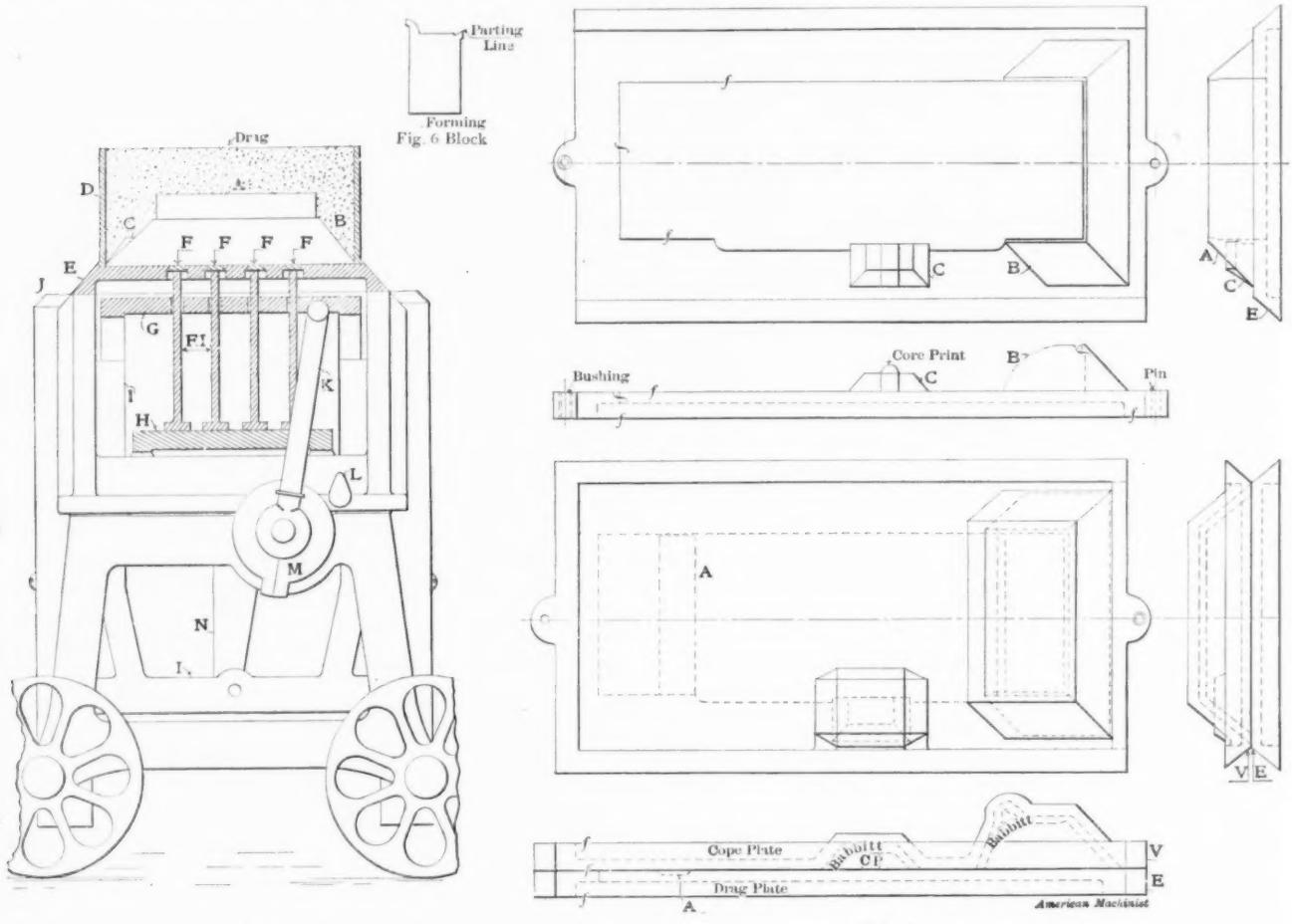
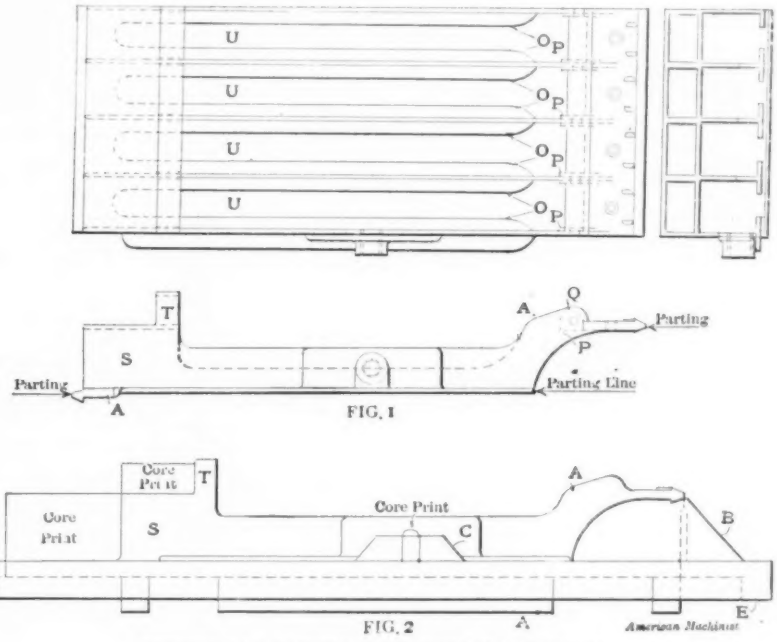


FIG. 3. FIG. 5.

A SHUTTLE-BOX PATTERN ON THE MOLDING MACHINE.

stool plate *H*. The stripping plate *E* is 1¼ inches thick around the outer edges and about ½ inch thick in the center, and it is cut out to the shape of the pattern, allowing 3-16 inch for finish. This gives a good stiff plate, the edges being beveled at about 45 degrees to allow any dirt that might fall off the edge of the flask to slide to the floor. The pattern plate also is made good and stiff to prevent its springing, and in the center of the plate are cut openings for stools *F* to pass through. Plate *H* is a plain flat plate. Have made or cast one iron plate off each pattern. Have them planed and drilled to fit the molding machine. Then the pattern of the shuttle box should be made, and the old master wood pattern can be altered into a molding machine pattern by adding on its under side sufficient stock to fetch it ½ inch below the adopted parting line. On each corner add a boss about 1¼ inches square and long enough to let the pattern rest on pattern plate *G*, and the parting line of pattern *A* to come in line with the top surfaces of plate *E* and building-up blocks *B* and *C*. Then in the center of each rib of pattern *A* on the under side add a rib ½ inch thick and down to the same length as that of the four bosses. This rib will keep this section of the pattern stiff; ⅛ inch finish is allowed on these bosses and under the rib. The top or original part of the pattern has only a file finish allowed on it. On one end of this shuttle box are a number of chambers (see *S* and *T*, Fig. 1). It will be necessary to core these chambers, so a balance core will be used, and the four chambers *S* will be cored with one core, and chambers *T* likewise, the core prints being fastened to the pattern *A* by strips through plate *E*. The end of the core print coming close to the end of the mold allows vent for the gas in the mold. There is one more, a round core, to be set in making this shuttle-box casting, and that is at building-up piece *C*. Half of the core print is set on the cope plate, while the other half is set on the drag stripping plate, but they are not set in their places until the babbitting is finished. The pockets *U* in the plan of the shuttle box, Fig. 1, are the pockets to be stooled out, so have a wood pattern made to the shape of the pocket *U*, and one end of it will follow the parting line from *O* to *P*. The shape of the stool on this end is better shown at *F*, Fig. 3. Stool *F* is about ¼ inch thick and is made of cast brass, only a file finish being allowed on the pattern. The pieces *F* are fitted into place and fastened to the upper finished ends of stools *F*1, Fig. 3, while these stools *F*1, being finished on their lower surfaces, are fastened to plate *H*.



SHUTTLE-BOX PATTERN AND BUILDING-UP PIECES.

THE FLASK.

The next point will be the flask to be used. In this case it is an iron flask, and so setting on the top of plate *E* that the ears on the end of the flask for flask pins correspond with similar ears on each end of plate *E*. A master wood flask pattern should be made and braced to hold it in shape until one iron pattern is made from it; then from this iron pattern flasks can be made as needed. Each iron flask should be planed true on the surface which rests on plate *E*, Fig. 3. A small lip should be cast on the lower inside edge of the flask to prevent the sand from slipping out, lifting the mold from the machine. After the flasks have been planed they should be drilled for the flask pins and bushings. Many firms make a mistake in not doing this drilling accurately. A jig should be made for this purpose, and then all will be drilled alike. There should be a pin in one end of the flask and a bushing in the other end. When all are drilled and fitted, then take and try them, and should any one work hard it should be eased up, as in this type of machine the flask pins are not stripped, but are lifted out by the operator when he lifts the flask off the machine. Many molds are spoiled, and operators are discouraged by the flask pin sticking; a little coal oil on them every morning is advisable.

THE COPE MOUNTING.

When the drag machine part is completed then have a pattern and casting made of the cope plate *V*, Fig. 5. This plate *V* must have a pocket made in it similar to and in the same locations as building-up pieces *B* and *C* of drag plate *E* would come if setting on top of plate *E* face to face, as in Fig. 5. The pocket should be made large and deep enough to give a 5-16-inch clearance all around the building-up pieces. This 5-16-inch place is for babbitt; the thickness of iron thru this pocket is ½ inch; so after the casting of plate *V* is planed and drilled to fit the molding machine, then drill a series of small holes ½ inch apart all over the inside face of the pocket. Drive nail heads into these holes, leaving the heads about 3-16 inch from the casting. Now set plates *E* and *V* together as in Fig. 5; put a binding pin through the flask-pin holes and bushings, and if the two plates come together without hitting the nail heads then remove them, and through the ½ inch of iron in each pocket drill a ½-inch hole for pouring the babbitt.

Now there are several ways of accomplishing the babbitting and in this case the odd shape of the parting line on the interior of the pattern *A* makes a little extra work and expense. I would use in this case a special forming block, Fig. 6, which conforms to the shape of the under side of pattern *A*, Fig. 1. The wood patternmaker can make this forming block, allowing only file finish on it, and deep enough to set on the top surface of pattern plate *G*.

BABBITTING.

When the metal patternmaker gets this casting he can readily fit it in place on the drag machine, elevated the same distance above the stripping plate, or lower straight parting line, to bring its upper surface in the same relative position as to the other parts of the pattern as the under surface of pattern *A* shows in Fig. 1. Then the stool should be set in its proper position as it would be when making a mold. The gaps where pattern *A* ribs would come up through are plugged up with a piece of wood or cardboard or putty, so that there will be no outlet for the hot babbitt. Set the cope plate on top of the drag plate, clamp them firmly together and with a wad of putty make a little funnel around the ½-inch pouring hole and pour in the hot babbitt. It is sometimes advisable to heat the plate a trifle before pouring, as it insures a better cast. When the babbitt has sufficiently cooled, remove the plates, take out the forming blocks, Fig. 6, and place the whole

pattern *A* in place on the machine. Clear off the putty or cardboard that was put in to stop the babbitt from running out, then put the half-round coreprint on building-up piece *C*, and the drag machine is complete. Take up the cope plate, dress off any fins on the babbitt and with emery cloth smooth up all the babbitt surfaces. Put the half coreprint in pocket *C* to correspond with half coreprint on building-up piece *C* in plate *E*, then carefully lay off the location of cope section of pattern *A* and screw this section pattern down fast to plate *V*. Then this plate *V* is to be drilled and fitted with flask pin and bushing and can be mounted on any old stand or buck sufficiently strong and of proper hight, and the job is ready for the foundry.

The custom is to run the machine along the sand pile as fast as the floor is filled with molds. The machine shown is the Draper-Tabor hand, round machine, of stripping-plate type, now used in many foundries. To make a mold the patterns are elevated to the uppermost position by means of the handle at the side of the machine. Then the flask is set in place, filled up and rammed and vented; then the patterns are withdrawn by turning the handle back again; the mold is lifted from the machine and set on the floor. The cope is rammed up in the same way and set on the drag. Cores should of course be set in place before the mold is closed.

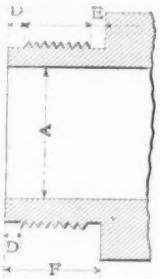
For one dollar 11,200,000 British thermal units may be obtained, on the assumption that one ton of coal of a calorific value of 14,000 British thermal units costs $2.50 per ton. The heat equivalent of one electrical horse-power year is 22,400,000 British thermal units. Assuming the value of one electrical horse-power year generated by steam to be fifty dollars, 450,000 British thermal units will cost one dollar.—*Electrical Review.*

Fire-Hose Couplings.

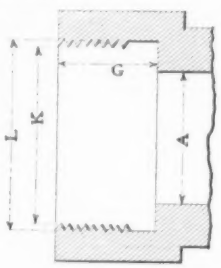
As our readers will recall, we have had quite a little to say first and last regarding the fire-hose-coupling question and the lack of a common standard for such couplings as made for different towns throughout the country. We have recently received from Mr. John R. Freeman some interesting and valuable data pertaining to this subject, these data having been gathered in 1892 when Mr. Freeman, then engineer of the Inspection Department of the Associated Factory Mutual Fire Insurance Companies, began an investigation to determine the possibility of securing a standard coupling for hydrants and hose. Several manufacturers gave permission to have their samples of the many different couplings by which they duplicated orders from various parts of the country, measured and the results obtained by measuring a large number of these samples with micrometer calipers were tabulated. The tables then compiled have recently been rearranged with the idea that they may be of service in connection with the attention about to be given to the subject by a committee which has been appointed by the National Fire Protection Association.

In the tables before us particulars are given of sample couplings and hydrant nipples for some 700 different towns. Of 525 cases 18 per cent. are cut 6 threads per inch, 29 per cent. 7 threads, 21 per cent. 7½ threads, and 32 per cent. 8 threads per inch. The smallest male coupling in the list has an outside diameter of thread of 2.690 inches and the largest 3.645 inches. Of fifty cases threaded 7 per inch the average outside diameter is 3.070 and the diameter at the root of the thread 2.867 inches; while the average outside diameter for fifty threaded 8 per inch is 3.047 and the diameter at the thread root 2.853 inches. There are just six couplings on the list of those having 8 threads per inch which conform to the New York standard of 3-inch outside diameter of thread, although there are quite a number so near this size that it may be assumed in their case the intention was to follow this standard when the original sample couplings were made.

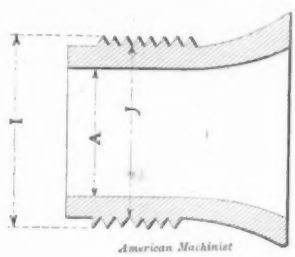
We believe the accompanying table embodying a few selections from the data collected by Mr. Freeman will be of interest. As will be noticed, no two of these couplings or nipples agree in respect to diameter of thread, and in only a few instances is there agreement as to thread depths. Perhaps the most interesting sections of the table are columns H and M, the one showing the shape of the top of the thread on the members used as gages, and the other what these gages



MALE HOSE COUPLING



FEMALE HOSE COUPLING



HYDRANT NIPPLE

Location.	A.	B.	H.	H. H.	I.	J.	K.	L.	M.
Altoona, Pa.	2½	6	F. Slg.	. .	3.093	2.825	2.925	3.120	Female Coupling.
Dayton, O.	2½	6	R.	3 1/16	3 220	3 005	. .	. .	Nipple and Cap.
St. Paul	2½	6	R. Good Deal.	3 7/32	3.200	3.000	3.055	3.279	Nipple and Female.
Milwaukee	2 9/16	7	R.	3 1/32	3 039	2.896	. .	. .	Nipple and Cap.
Rochester	2 1/16	7	R. Very Slg.	3 3/32	3 028	2.822	2.900	3 060	Nipple and Female Ring.
Terre Haute	2½	7	R. Slg.	3 1/16	3.062	2.879	2.915	3.123	Nipple and Female Ring.
Detroit	2 15/32	7	R. Slg.	3⅛	3 136	2.959	. .	. .	Old Male and Cap.
Atlanta, Ga.	2½	7½	F. Slg.	3 1/32	3 022	2 850	2.890	3.049	Nipple and Cap.
New Britain, Conn.	2 1/16	7½	S. R.	2 13/16	2 942	2 760	2.833	2.985	Old Coupling.
Providence	2½	7½	R. Slg.	3 3/32	3 088	2.899	. .	. .	Nipple.
Worcester, Mass.	2½	7½	R	3 1/16	3 067	2.902	2.923	3.100	Old Coupling.
Hartford	2 7/16	7½	F. Little.	2 15/16	. .	. .	2.817	2.972	Female Only.
Denver	2 11/16	8	R. Slg.	3 3/32	3.082	2.894	2.959	3.116	Nipple and Female.
Houston	2 7/16	8	R. Slg.	2 31/32	2.994	2 819	. .		Nipple Only.
New York City	2½	8	Male F. Slg.	2 31/32	3.000	2 832	2.908	3.036	New Coupling.
Orange, N. J.	2½	8	Well Rounded.	3	2.985	2.842	2 875	3.024	Coupling.
Syracuse	2 7/16	8	R.	3 5/32	3.153	2.964	3 022	3.236	Male and Female Rings.
Tampa, Fla.	2½	8	S.	3	3 005	2.806	2.870	3.022	Nipple and Female Ring.
Toledo	2 7/16	8	R.	2 31/32	2.978	2 806	. .	. .	Nipple and Ring.
Montgomery, Ala.	2½	8	F. Slg.	3	2.999	2.831	2.921	3.045	Nipple and Female.

TABLE OF HOSE COUPLING DIMENSIONS.

A.—Bore. As many of the nipples were not finished out to size, these dimensions are not very close, except where gage consisted in part of a male coupling or wholly of a female coupling. B.—Threads per inch. H.—Remarks on top of Thread: S., Sharp; R., Rounded; F., Flat; Slg., Slightly; S.-R. or R.-F., difficult to say which. The fraction gives estimated amount of round or flat. H. H.—Diameter of top of male thread per manufacturer's list. I.—Diameter of top of male thread. J.—Diameter of bottom of male thread. K.—Diameter of top of female thread. L.—Diameter of bottom of female thread. M.—What gage consisted of. As nearly all these gages were more or less worn, the remarks under H.H. refer to their appearance at date of measurement only.

actually consisted of, at the time the measurements were taken. From the latter column it will be seen that the gage for the couplings for a certain town may consist of a female coupling, or it may be made up of a nipple and cap, a nipple and female, or an old male coupling and cap; the threads in some cases being slightly flatted, in others slightly rounded, in still others rounded or flatted considerably.

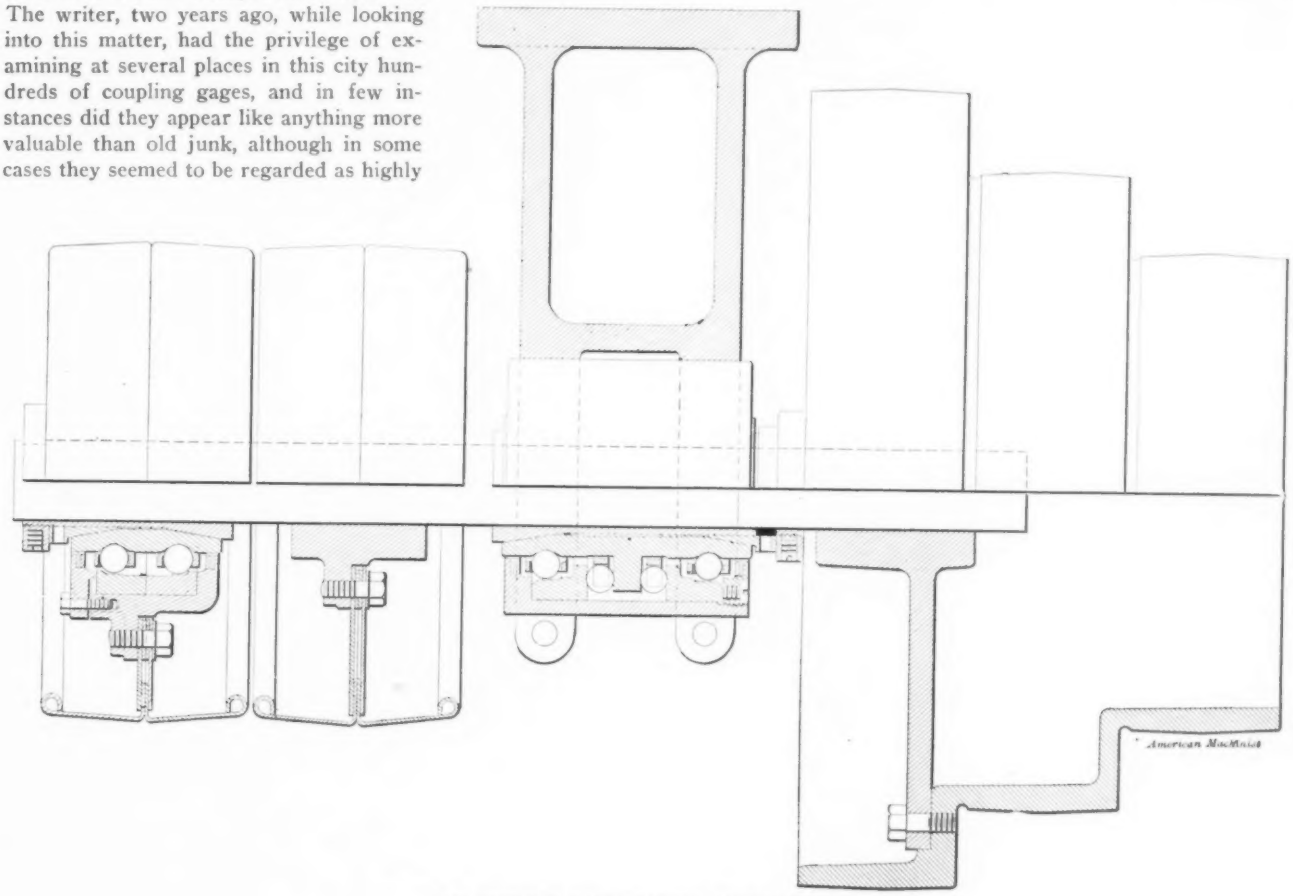
It may seem strange that such a collection of brass rings, caps, nipples, etc., with threads in such condition that no one can tell what their original depth or shape was intended to be, should serve as working gages in the manufacture of hose couplings; such gages, however, are the only kind used for this work, so far as we know. The writer, two years ago, while looking into this matter, had the privilege of examining at several places in this city hundreds of coupling gages, and in few instances did they appear like anything more valuable than old junk, although in some cases they seemed to be regarded as highly as if they were hardened and ground steel gages, made with the highest degree of accuracy.

In addition to the differences in thread diameters and depths and other particulars embodied in the table which we present, the very complete tables from which these particulars were obtained show the differences in coupling lengths and in the number of turns of perfect thread, in regard to which each gage seems to be more or less a law unto itself. We believe no one can look over the data in these tables without feeling that the whole hose-coupling matter is one which ought to be the subject of investigation and reformation at the earliest possible moment.

An English Countershaft With a Single Hanger—Visit to an English Ball-Bearing Factory.

A machine countershaft supported by a single hanger was noticed recently on the occasion of a visit to the Hoffman Manufacturing Company, Ltd., Chelmsford, England. A cone pulley was on one side of the hanger and on the other was a friction clutch, and the device, while reducing the space taken by the countershaft, also simplifies its fixing. A section is here given, a fast and loose pulley being fitted, however, in place of the clutch. The loose pulley, like the hanger, is supplied with a ball bearing.

The company mentioned, as the result of many tests, has come to the conclusion that it is impossible to design a satisfactory ball bearing to take both journal and axial load or end thrust. Their compound bearings, such as are used in the case of the hanger, are therefore designed with separate rows of balls to take the two loads, and this will explain the construction of the central bearing. The two outer rows are for the ordinary bearing load, while thrust in either direction is received by one or other of the two inner sets of balls. In each case the load is taken by the ball at right angles to the axis of its rotation, spinning of the balls being thus avoided. Canting is resisted by all four rows of balls. The cone for the ball races is clamped on a bush, one end of which is tapered, while the other end carries a taper bush against which the end nut bears to tighten up the whole. The end nut is locked by a grub screw. For the bearing itself adjustment is made by a disk nut which in turn is locked by a screw, the cheesehead of which is let into the housing. The retaining cages for the balls float with them and obviously prevent their bearing on one another. As to the loose pulley, end thrust being absent, balls for the ordinary journal bearing are alone provided. In this case the race cone is ground to fit a steel sleeve which is split, the nut on the end pulling up the whole and clamping the sleeve to the shaft. Built-up steel pulleys of the type illustrated are a standard product of the company.



AN ENGLISH BALL-BEARING COUNTERSHAFT.

A STEEL BALL FACTORY.

The company mentioned turns out steel balls which are guaranteed to be perfect as to spherity and size within 1-10,000 inch. They prefer to keep their methods to themselves, particularly as to the grinding of the balls, but possibly the following notes may be of interest: In one room they have automatic machinery which will produce from the rod one million balls a day, these being turned to within 1-2,000 inch of size. The limits of diameter are ⅛ inch and cricket ball size. Each machine has two cutters, flooded with lard oil, and it undertakes four operations at

once, from a first rounding up to parting off. For the final operation the ball is held in a revolving jaw so that no pip is left on it when severed from the rod. As to the speed at which each machine works, it may be said that of ⅛-inch balls, such as are used for cycle free wheels, pedals, etc., forty-five are made in a minute. In this room one lad attends to six machines, and a special Watson-Laidlaw centrifugal is used to spin the oil off the balls as they come from the automatic machines. For hardening the balls gas furnaces are used, the balls being dropped thru a hopper into a drum which, for uniform heating, revolves. They are taken through by a worm and discharged at the right time into a tank for hardening. The bearing races are dead hard on the surface but tough inside. They are made of the best mild steel, tool steel having long since been found unsuitable. Brown & Sharpe furnaces are used for the annealing and carbonizing processes. The balls are of crucible cast steel and the necessary testing follows all the operations.

For heating the factory, exhaust steam is used, a fan sending heated air through special ducts in the buttresses of the building so that fresh, warm air is supplied in every workroom during winter. In warm weather the ordinary air is sent through the ducts to remove all smell of oil, etc. The building has a pleasant outlook in all directions and provides plenty of air space for the workers, while washing and other conveniences are on every floor. Another noticeable thing in the factory is a lift which is driven by worms. Of these there are two, one on each side, with an electric motor between them. The worms run at the sides on vertical axes, in a series of circular teeth having ball bearings, and side rock is also taken on anti-friction rollers. The writer was shown ball bearings in an electric motor which had been running for two years, often day and night, without being lubricated. For this, however, the balls must not rust or brittle in the ball race. The bearings are initially filled with a heavy lubricant such as motor grease—not oil, which is to be avoided unless a flood or bath is provided. Unless the bearing is heated externally the grease seldom need be renewed. It is retained by a leather washer let into the housings at each end, the washers also excluding dirt. Of course it has been recognized for some time that in a well-designed ball bearing, kept cool and clean, lubrication does not reduce friction. I. W. C.

Piercing, Blanking and Bending Dies.

BY P. SANDISSON.

In the accompanying sketches are shown the blanking punch and die and also the bending die for producing the blank and bent pieces seen in Fig. 2. The material used for these pieces was No. 16 B. & S. gage (0.058 inch) half hard sheet brass.

The die block *c*, Fig. 1, is of tool steel worked out to the shape as shown, then hardened and ground. The stripper plate *d* is of mild steel fastened by screws to the die block and dowelled; *e* is the gray-iron bolster. The stop finger *f* is similar to those previously shown in the AMERICAN MACHINIST and which appear to be adopted by several manufacturing concerns.

The punch holder *g* is a mild steel forging machined as shown, the piercing punches *j* and the blanking punch *k* are fixed into the mild steel plate in the ordinary manner, the plate then being fastened to the punch holder *g* in the same way as stripper plate *d*; *l* is the adjustable tripper for the stop finger *f*.

Particular attention is called to the location of the piercing holes and the blank slot in the die block *c*. These are placed at 45 degrees, the reason for this being as follows: In the first and second bending operations it will be noticed there is a double bend, as indicated at *x x*, Fig. 2. Now, if the blank were cut either with the grain or across the grain, there would surely be trouble in making one or the other of these bends. The material was cut in long strips, with the grain, as indicated in Fig. 4, and punched in the manner shown.

At *m* is shown the method of holding the guide pins in the blanking punch *k*. The ordinary method of fitting these pins directly into the punch is unsatisfactory. In this case the punch is drilled and counterbored and then hardened, after which a mild steel plug is driven into the counterbored hole, and this plug is then properly laid out and drilled to receive the guide pin, thus ensuring accuracy.

The construction of the bending dies is clearly shown and no lengthy explanation is necessary. *N* is the tension pad, whose action will be readily understood; *p p* are gage plates for locating the blank for the first bending operation; *r* is a clearance groove only. These dies are simple in construction, yet have given perfect satisfaction.

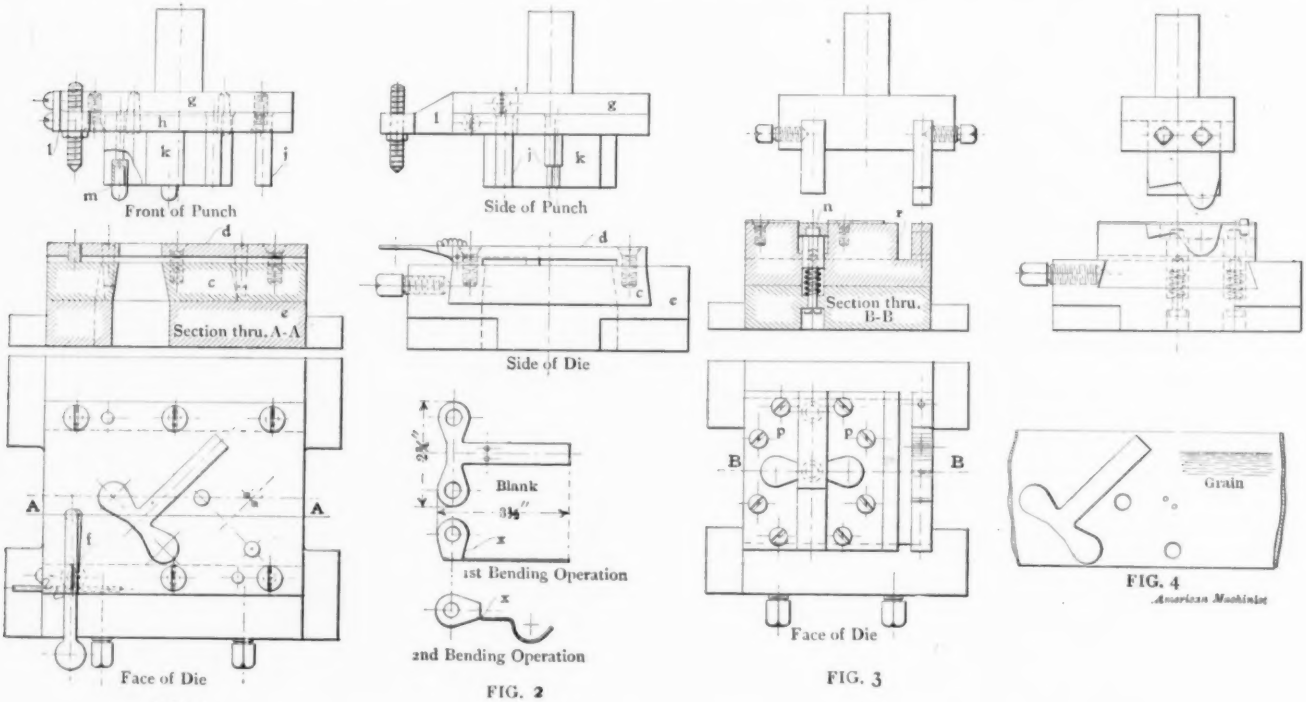


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

PIERCING, BLANKING AND BENDING DIES.

Feeds and Speeds for Lathe Work.*

BY T. A. SPERRY.

To the manufacturer of machinery the subject of feeds and speeds is an all-important one, and yet it is one of which less is known in a systematic, comprehensive way than of almost any other branch of shop development. While men have been working iron and steel from time immemorial, and while the machine tool, as such, in all its present forms, though in a greater or less degree of perfection and adaptability, has been in use for a great many years, it is only within the past six or eight years that men have realized the real capabilities of this class of tool as a work producer, and have given the subject of maximum output any real, earnest, intelligent thought and attention.

The object of this paper is to present the results of observations at the works of the Cincinnati Milling Machine Company, showing the speeds and feeds at which iron and steel are being machined to-day. I have not gone into the subject very deeply, and have made no startling discoveries, nor have I any new theories to advance. I have only endeavored to formulate in a systematic manner present shop conditions and practises in a manner suitable for calculations.

While a little has been done on other classes of work, I shall in this paper deal primarily with lathe work, for the double reason that it is the most important of our machining operations, and that it is generally conceded to be the most susceptible to the influence of modern high speeds. If this work can be systematized, the same course of treatment, slightly modified, can readily be adopted to other forms of tools and methods of cutting.

In making and recording observations for this work, I have had constantly in view the objects (1) of regulating and establishing both time and methods of work on specific operations for specific pieces of work, and (2) ascertaining the *best* conditions of and for the general machine (lathe) work for this class of manufacture, *i. e.*, a high grade of machine tool construction. These conditions must necessarily be fully established before any attempt is made at laying out a comprehensive scheme of speeds and feeds to govern the operations of general machine work.

METHOD OF RECORDING AND PLOTTING OBSERVATIONS.

I shall here, however, consider only the second sub-division of the general field—that of the *general* speeds and feeds of lathe work. For this, hundreds of observations have been made on work actually being done in the shop, and when the best conditions for a job have been ascertained the observation has been recorded serially by a card-index file. Each card contains seventeen distinct sets of observations, each of which is a complete history of that particular operation, showing speed of cutting, travel of carriage, depth and area of cut, material, nature of work, name of piece, man and machine number, notes, date, etc. These observations are then classified on other cards according to material, and subdivided according to the nature of the operations, and these classified records are then transferred to cross section paper, plotting the speeds as ordinates and the areas of the cuts (equivalent to the lead times depth of cut) as abscissas; and through the points thus located a curve is drawn, showing the average practise of the department for this particular class of work and kind of cut. Each point located on the co-ordinate

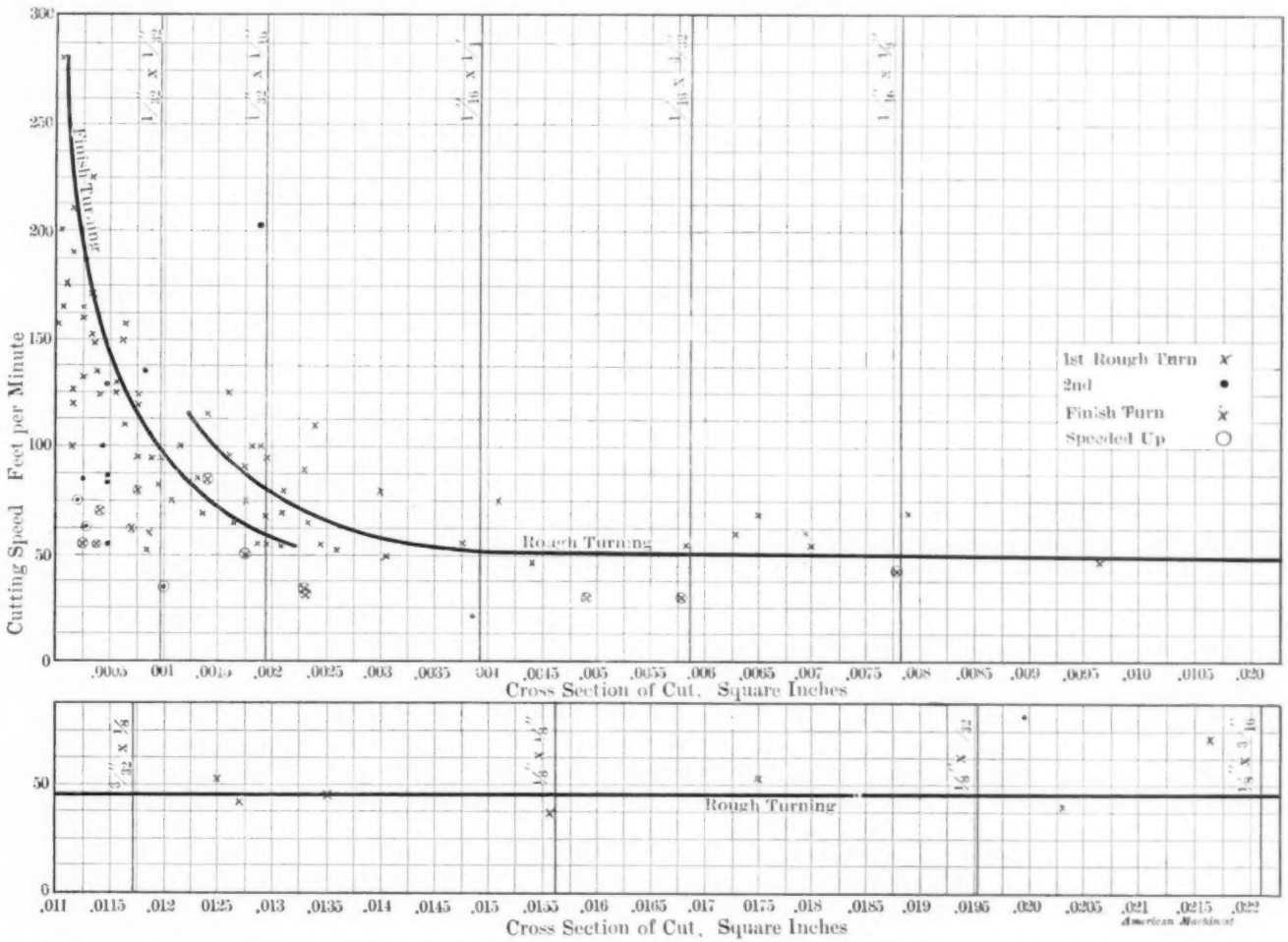


FIG. 1. RELATION OF CUTTING SPEED AND CROSS-SECTION OF CUT. FROM DAILY PRACTISE IN ROUGH AND FINISH TURNING OF GRAY IRON.

*A paper read before the Cincinnati Metal Trades Association.

paper has a reference number attached to it*, by which it can be traced back to the primary card record. Take, for instance, on th curve for rough turning gray iron, the point at the intersection of 80-feet cutting speed and .0021 square inch area of cut, and referring back to its card we find the complete details of that job, showing that, as a result of experiment, the cutting speed had been increased from 40 to 80 feet and the travel from 1⅝ to 2⅝ inches per minute, using a rather finer feed. Whenever an observation is plotted which later on is increased a circle is drawn around it, indicating that better results were afterward obtained. Curves have thus been plotted for the principal turning operations on gray iron, machine steel, tool steel, bronze, etc., those for turning gray iron and machine steel and for facing gray iron only being here reproduced.

The machine steel sheet, Fig. 2, has, part of the way, a double line for rough turning, the upper line being from certain heavy work on which heavy cuts could be taken and a special effort was made to obtain the highest possible speed without much regard to the life of the tool. At these speeds and cuts the tools would last from two minutes to half an hour each. The curves, as a whole, represent better than the average work of the department, for the records show that about 32 per cent. of the observations had been speeded up by amounts ranging from 5 per cent. to 115 per cent. of the original speeds, or an average of about 15 per cent. on all of the observations recorded; and, moreover, the shop is universally known as a "speed shop."

*Omitted from the engravings.—Ed.

Kind of Cut.	GRAY IRON. Speed Cutting.	Area of Cut.	Weight Removed.	MACHINERY STEEL. Speed Cutting.	Area of Cut.	Weight Removed.
	(Feet per min.)	(Sq. Inches.)	(Lbs. per min.)	(Feet per min.)	(Sq. Inches.)	(Lbs. per min.)
TURNING: Scale—						
Minimum.	32	.00079	.1566	40	.00077	.0450
Average.	65	.00316	.4869	80	.00698	1.718
Maximum.	115	.0078	1.1340	163	.01560	5.148
2d Cuts—						
Minimum.	35	.00028	.0479	45	.00008	.0015
Average.	90½	.00146	.4138	68	.00053	.1396
Maximum.	135	.0065	1.3395	150	.00156	.3744
Finish—						
Minimum.	70	.00004	.0228	68	.00005	.0004
Average.	140	.00045	.1388	115	.0011	.0310
Maximum.	240	.0013	.2925	390	.0016	.2568
FACING: Scale—						
Minimum.	43	.00079	.1612	41	.0004	.0550
Average.	87	.00239	.5094	75	.0032	.4170
Maximum.	140	.0078	1.0062	110	.0059	1.718
2d Cuts—						
Minimum.	45	.00011	.0182	45	. .	. .
Average.	131	.00195	.5592	100	. .	. .
Maximum.	265	.00800	2.720	260	. .	. .
Finish—						
Minimum.	80	.00003	.0100	70	. .	. .
Average.	154	.00026	.1266	130	. .	. .
Maximum.	285	.00065	.3544	325*	. .	. .

GENERAL RESULTS FROM 400 RECORDS OF ROUTINE LATHE WORK, TURNING AND FACING GRAY IRON AND MACHINE STEEL.

COMPARISON WITH ENGLISH AND GERMAN RESULTS.

As a matter of interest and comparison, the curves shown have been plotted in Figs. 4 and 5 with the results of the elaborate experimental tests made by the

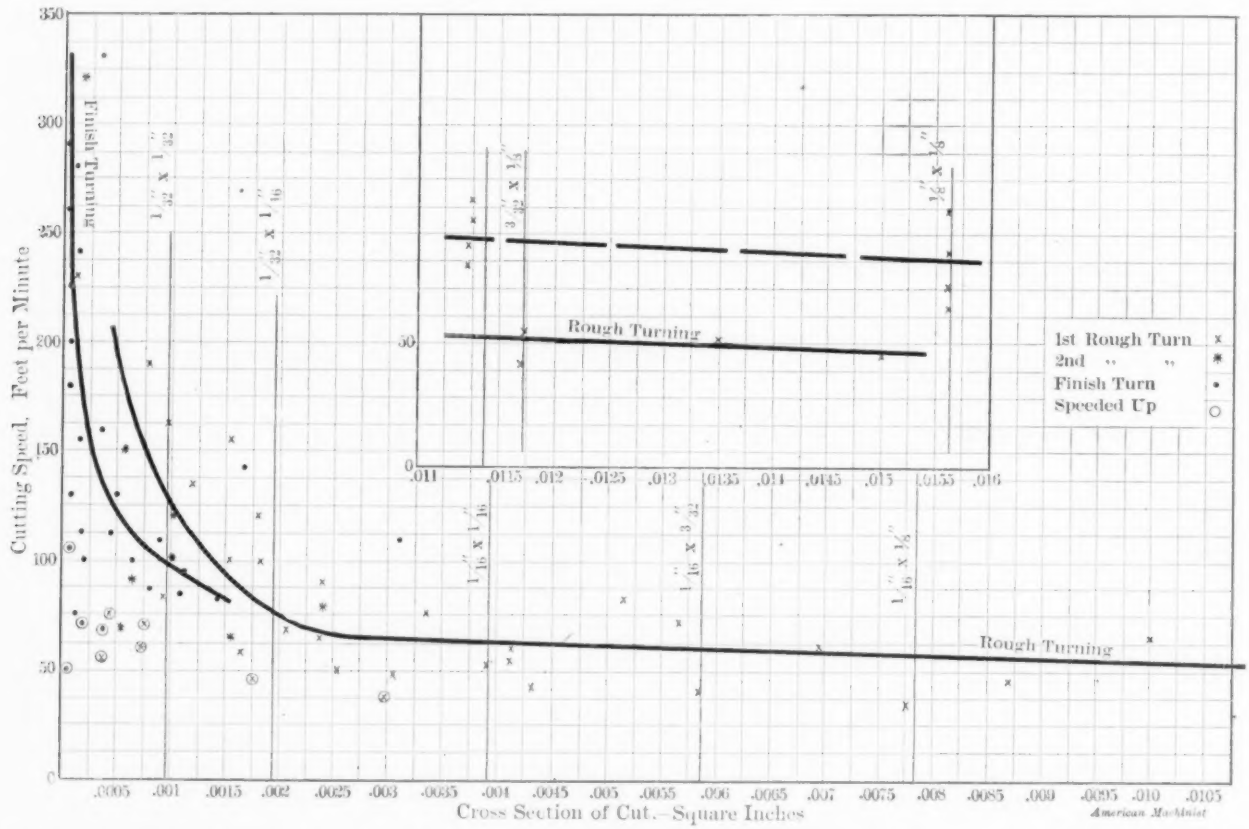


FIG. 2. RELATION OF CUTTING SPEED AND CROSS-SECTION OF CUT. FROM DAILY PRACTISE IN ROUGH AND FINISH TURNING OF MACHINERY STEEL.

Manchester Association of Engineers (Report of December, 1903), and also with the results attained by the Association of German Engineers. The comparison, however, is hardly a fair one, for these association records were made on heavy work with heavy tools and with all conditions carefully adjusted, their sole object being to remove as much stock as possible in a given time, while in our own work (a) both machines and work are comparatively light; (b) the amount of metal (depth of cut) to remove is as small as consistent with good workmanship; and (c) the end

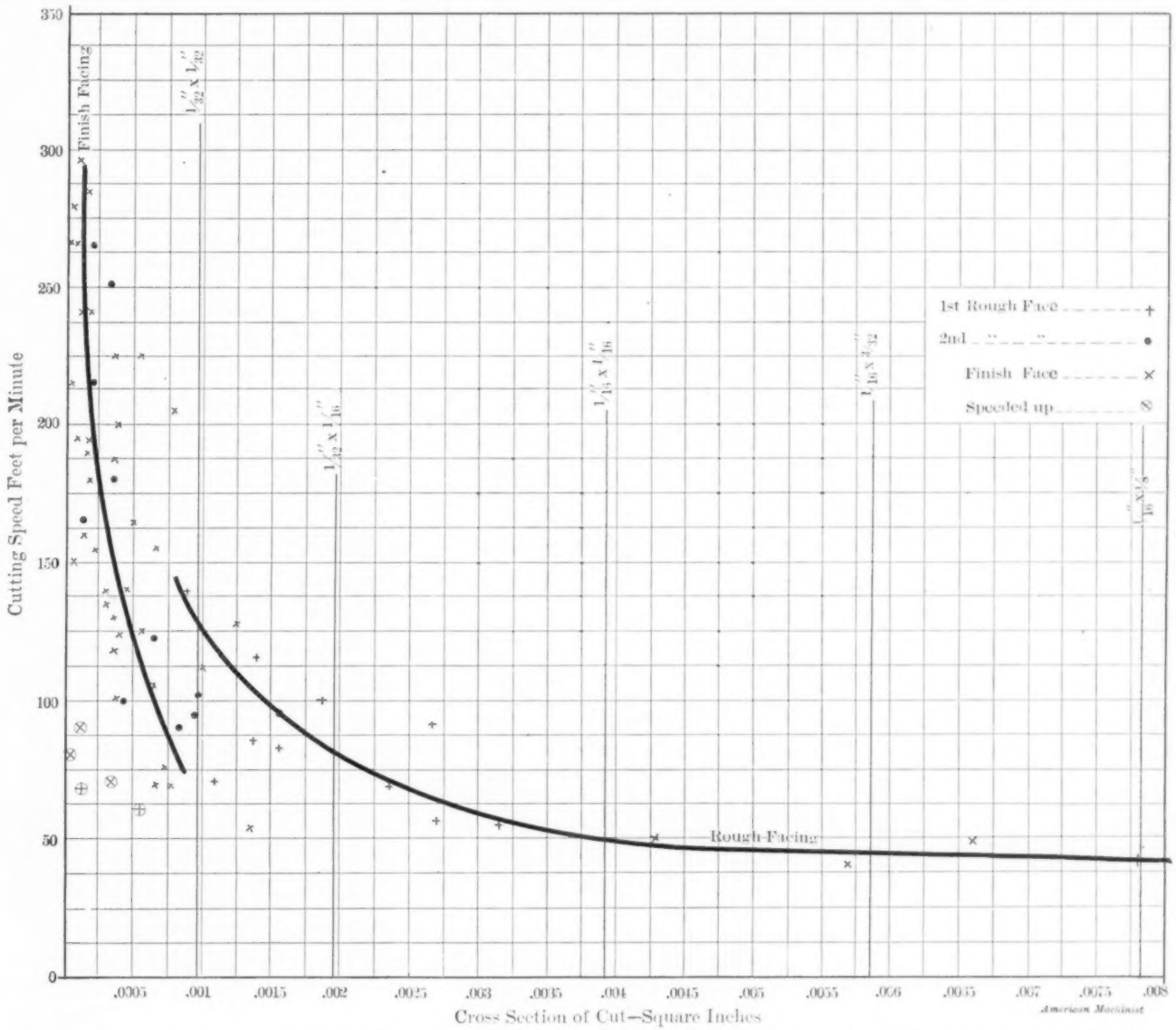


FIG. 3. RELATION OF CUTTING SPEED AND CROSS-SECTION OF CUT. FROM DAILY PRACTISE IN ROUGH AND FINISH FACING OF GRAY IRON.

aimed at is, above all, the quality and character of the finished surface. Even with these limitations, the roughing cuts show up very well in the comparison.

The table gives a general summary of the results obtained from some 400 observations made.

The curves, as plotted, seem to indicate definitely that with the heavier cuts the speed limit of the tools varies but slowly with the area of the cut, *i. e.*, that nearly the same speed can be maintained on a cut 3-16 inch deep by ⅛ inch lead as on a cut 3-32 inch deep by 1-16 inch lead, though in one case removing about three times as much metal as in the other. (In all the diagrams the amount of metal removed per minute is represented by the rectangular area enclosed by the co-ordinates of the point and the two base lines.)

No tree has yet been measured which was taller than the great eucalyptus in Gipsland, Australia, which proved to be 450 feet high.

To make a special glue of great tensile strength from 1 to 20 per cent. of zinc oxide is added to the hot solution of glue, and after well agitating the liquor is passed through a sieve and cooled in molds. It is claimed that the resulting glue, which is white and opaque, has a tensile breaking strength 20 per cent. greater than that of ordinary glue, while size prepared from it has a resistance to moisture 30 per cent. greater than ordinary glue size.

In Defense of Modern Education.

The following we take from an address at the annual dinner of Cornell University Alumni, at Chicago, April 1, 1905, by Walter C. Kerr:

The world wants men who can do things.

It is not probable that a few thousand young men assembled at random in one place differ materially from a like number assembled elsewhere, except as they are attracted by something that consciously or unconsciously appeals to them.

If we haven't enough education we aren't likely to get much more by talking about it, and if we have enough the time might be better spent on something we haven't got. It is of some interest to us what trend education is taking, if we are interested in what our sons will get. "The results of things follow not so much from their state as from their tendency," and so our interest is not so much in the kind of education that is being given at the moment as in the tendencies marked by

the changes which determine what it will become.

Cornell has played an active part in the development of education in this country. It started with strong initiative force through men who felt but hardly dared formulate their inclinations toward something which was better than that which had been. They were men who reached forward from the limitations which compressed their past to aspirations which they could not quite measure or define.

Nevertheless, in some way, consciously or unconsciously, there evolved from and through these men the power to do things, without too fixed a goal, but trusting that the results would be the best that right could make. *They went as far as they could see and then saw how far they could go.* This underlies the pioneer spirit. Men do not know what they are going to make of a new country and its resources, but they plunge in, turn it over and make of it the best they can; always in the spirt of industry and honesty; with that aspiration for betterment which invariably turns to good that which is worthy and turns to naught that which is undesirable.

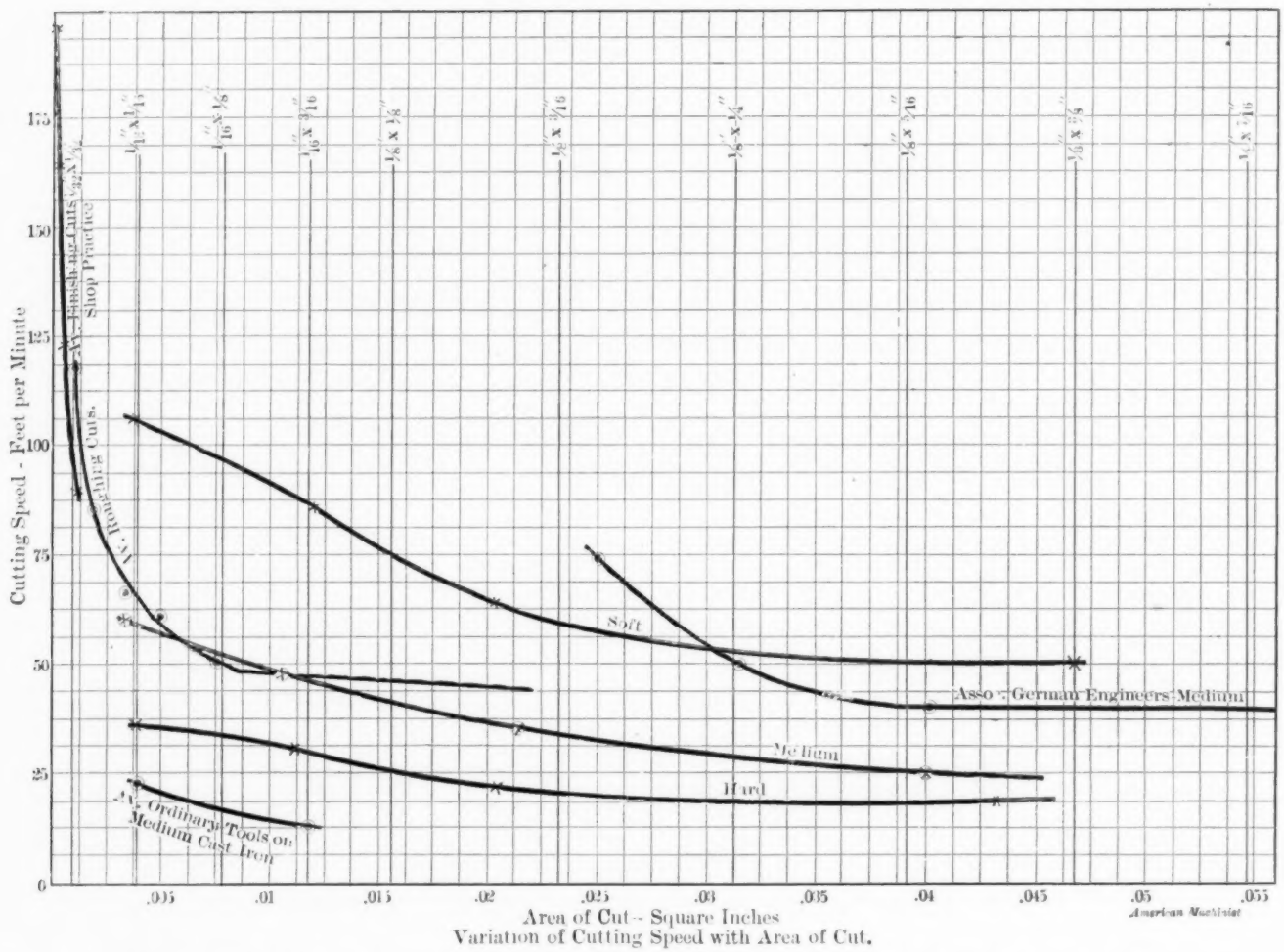
Thus Cornell started—with no entrammeling traditions; no compressing environment; surrounded only by the four winds of heaven; the courage of her convictions making her superior to criticism.

The result was a new kind of institution. It was called a poor man's college, but poor men are not quite so poor as they used to be, and it would be strange if they were, amid all the resources of this great country. Then followed the years of struggle filled with incidents which form the oft-repeated history of the early days. The day came, however, when through the sale of lands, the gifts of many benefactors, and the added talent of an ever-increasing faculty, we had a well-rounded university.

This was the result of influences which for a score of years had, from the rude beginnings on the Ithaca hill, shaped the ends which have reached deep into other institutions of learning throughout the land.

As a result we have 3,100 students, departmented as follows: Post-graduates, 200; Arts, 700; Law and Medicine, 600; Applied Science (chiefly engineering), 1,600.

Contrast this condition, where only one-fourth of the students are in the Arts



Variation of Cutting Speed with Area of Cut.

FIG. 4. COMPARISON WITH ENGLISH AND GERMAN EXPERIMENTAL RESULTS IN ROUGH TURNING GRAY IRON.

which though simple in themselves, were far-reaching.

I regard as the first of these the declaration that all kinds of education are equal. The democracy of this is so simple as to seem axiomatic, but that it was a departure is shown by the fact that after nearly forty years it is not yet quite universally believed.

The second I believe to be the proper view of the relations between the so-called liberal and utilitarian courses of study.

The third may have been the bold willingness to do the right thing every day and all the time as opportunity offered, course, with the old academic institutions with an eye to what education should consist of when a large number of intelligent men are left to freely choose what is best adapted to their needs.

The fact that under these conditions so few elect the humanities has often been deplored as the decadence of classical training. I do not think so. It is rather the beginning of a higher development in which the classical will be more effective because not diluted with the dregs of its own failures.

The time was when but one kind of education was known, or at least only one kind of training was called education.

Our early colleges were therefore strictly classical, and many are yet. An educated man was then perforce a classical man, and, since education led chiefly to the learned professions, the few who in the early days received college training were fairly fitted for their life's work. Then the so-called blind impulse for the old ideal of general culture led fewer men astray than it does now.

As time went on, institutions grew in size and multiplied in number. Thousands of students took the place of former hundreds. After a time we began to hear whispers from the practical world, which fined educators wrong, and for no uncertain reason. I think the whole problem is so simple that a few statements can take the place of argument, and especially of contention.

Humanity is composed of all kinds of men, possessing widely different temperaments, tastes and abilities. It is well they are not all alike. Any man will achieve the greatest effectiveness when given the opportunities and training which develop his native powers. Any other training is liable to stunt his growth. His variation, as he progresses in development, should be in the direction in which he riod of their development their native power to vary was resisted, their minds, forced away from their natural trend, and energies which could have been potent for good in certain directions, were dwarfed by the compulsory exertion of uninteresting, unproductive effort. This results in that kind of mediocrity which is stagnation.

You can't make anything good of a man except to make him better in that which he is. You can't unmake him and make him over again. If it be argued that a man must needs have the so-called liberal education in order to be well rounded;

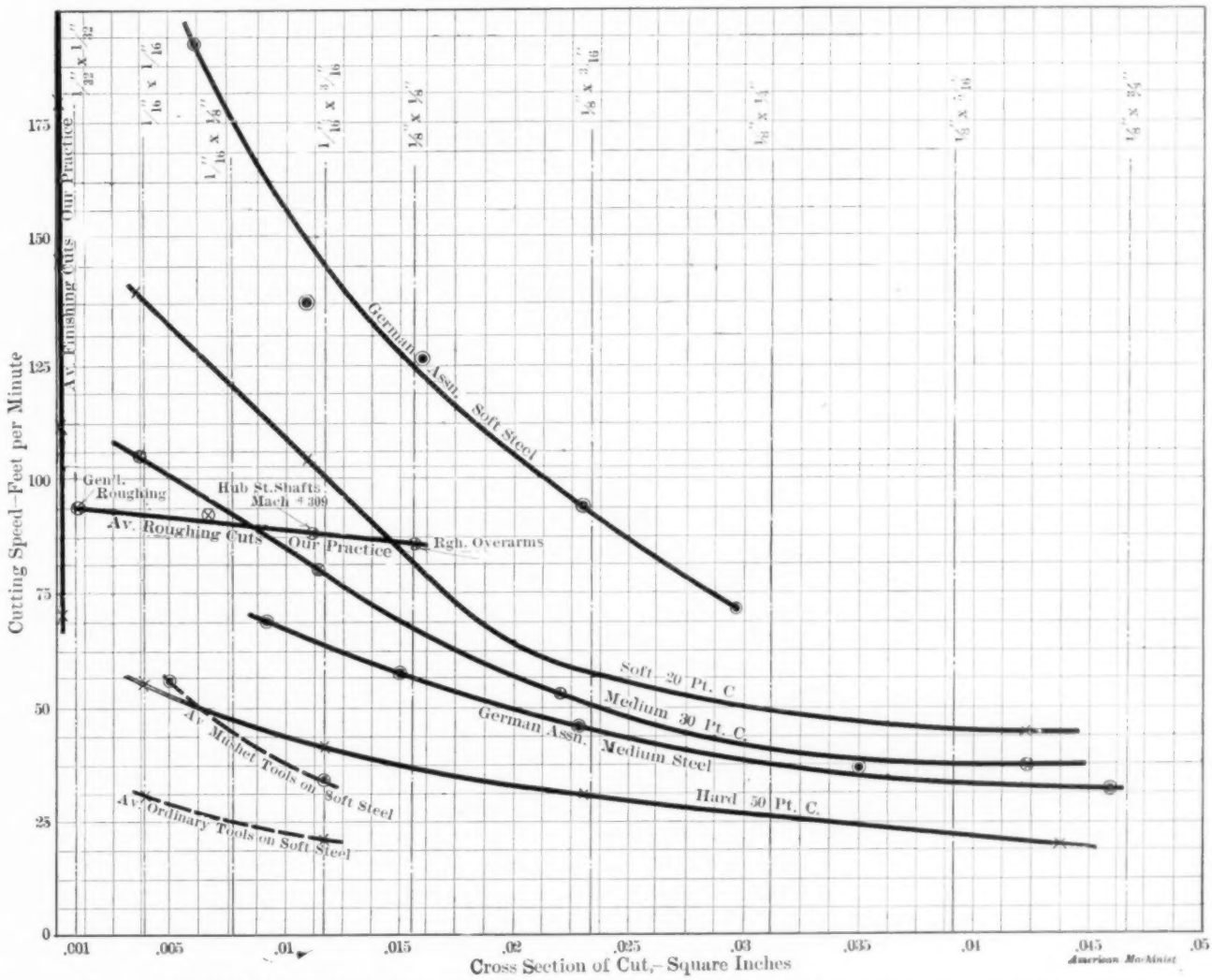

Cutting Speed—Feet per Minute
Cross Section of Cut,—Square Inches
Av. Finishing Cuts Our Practice
Gen'l. Roughing
Hub St. Shafts Mach. 309
Av. Roughing Cuts Our Practice
Rgh. Overarms
German Assn. Soft Steel
Soft 20 Pt. C.
Medium 30 Pt. C.
German Assn. Medium Steel
Hard 50 Pt. C.
Av. Milling Tools on Soft Steel
Av. Ordinary Tools on Soft Steel
American Machinist

FIG. 5. COMPARISON WITH ENGLISH AND GERMAN EXPERIMENTAL RESULTS IN ROUGH TURNING MACHINERY STEEL.

generally gets things pretty nearly right, that college education was a failure, that men who spent four years and thousands of dollars in academic halls were less fitted for the activities of the world than those who spent these developing years in business or other pursuits.

Educators used everything from argument to ridicule by way of refutation, commonly alleging that men without education were unfitted to judge the product of our institutions. I think the apparently crude judgment of the world was right and the ineffective theories of many re-

tends to vary. This assists in the survival of the fittest, the survival of the unlike, the survival of the effective.

Manifestly there must be as many types of education as there are types of men, and fortunately the number is not so great but that they can be readily supplied within any university. So long as all men during the process of education were confined to one channel, those whom the channel precisely fitted were greatly benefited. Those for whom the channel was a misfit were injured, for the reason that during the most important formative pe-

following this with the so-called specialized courses, the answer is that he can be forcibly made well rounded like a billiard ball without other characteristic than roundness. He ought to have corners, and the corners should be left on to dent something.

As to the so-called specialized courses, these are only names. They are no more special than the humanities. Some are scarcely so highly specialized.

The older I get, the more I think that there is no such thing as liberal education, liberal arts, or liberal anything, as

distinct from specialized departments of knowledge. Liberality is the free and equal admission of all.

We have heard too much about knowledge for its own sake versus knowledge for use. All knowledge is for use. All education is for action. The engineer uses mechanics and thermo-dynamics in a certain direct way. The architect uses art and constructive knowledge in a similar way. The lawyer uses his knowledge in a less material way. The classical or philosophical man uses his acquirements in a different way, but if he does not use them they are useless. All education is liberal or all is technical, according to our definitions; but all is for use.

When it is observed that less than 25 per cent. of the students follow classical pursuits when left free choice, and that over 75 per cent. select professional and industrial education, there is good reason to believe that this is about the proportion in which men's minds are fitted to receive benefit from the acquirement of the respective classes of knowledge and training. I therefore maintain that, instead of a decadence in the humanities they are elevated, because their representatives are men whose minds are fitted to take such education, and who will therefore conspicuously represent the best possibilities of classical training applied to those to whom it is adapted.

Likewise, by processes of natural selection, the other departments will have graduates who are conspicuously strong because their best efforts will be put into that which they can do best. I know of nothing pointing more directly to success than that.

It is not necessary to consider the relative merits of the various kinds of education. There is room for all, because there are all kinds of men. It is useless to say I am better than thou, or this is better than that. But one thing is better than everything else, and that is the broad spirit which recognizes that all education is equal, that training is training whenever you find it, knowledge is knowledge, no matter of what it consists, that human effort is human effort, no matter to what it is applied, and when it has singleness of purpose and is resourceful, it is effective.

German Vertical Keyseating and Slotting Machine.

This machine is chiefly used for keyway cutting, and in its simplest form, which is used only for operating on shafts, the work is mounted in V-blocks fastened to a stationary table, several sizes being used to include all diameters within the given range. In the more universal type, shown by the illustration, Fig. 1, the table is provided with cross and vertical hand adjustment, thereby increasing the adaptability of the machine and rendering it more serviceable for a general class of work.

The novelty of the machine lies in its method of operation, which is as follows: The cutter which is of the same diameter as the width of the groove to be cut, is securely fastened to the spindle, the latter rotating in a sleeve of large diameter, which is non-rotating and provided with self-acting vertical feed. After the hole has been bored to its full depth the vertical feed is automatically disengaged and the longitudinal traverse of the carriage simultaneously thrown into action. The carriage then feeds along the bed, milling out the full width and depth of the slot in one cut until the required length has

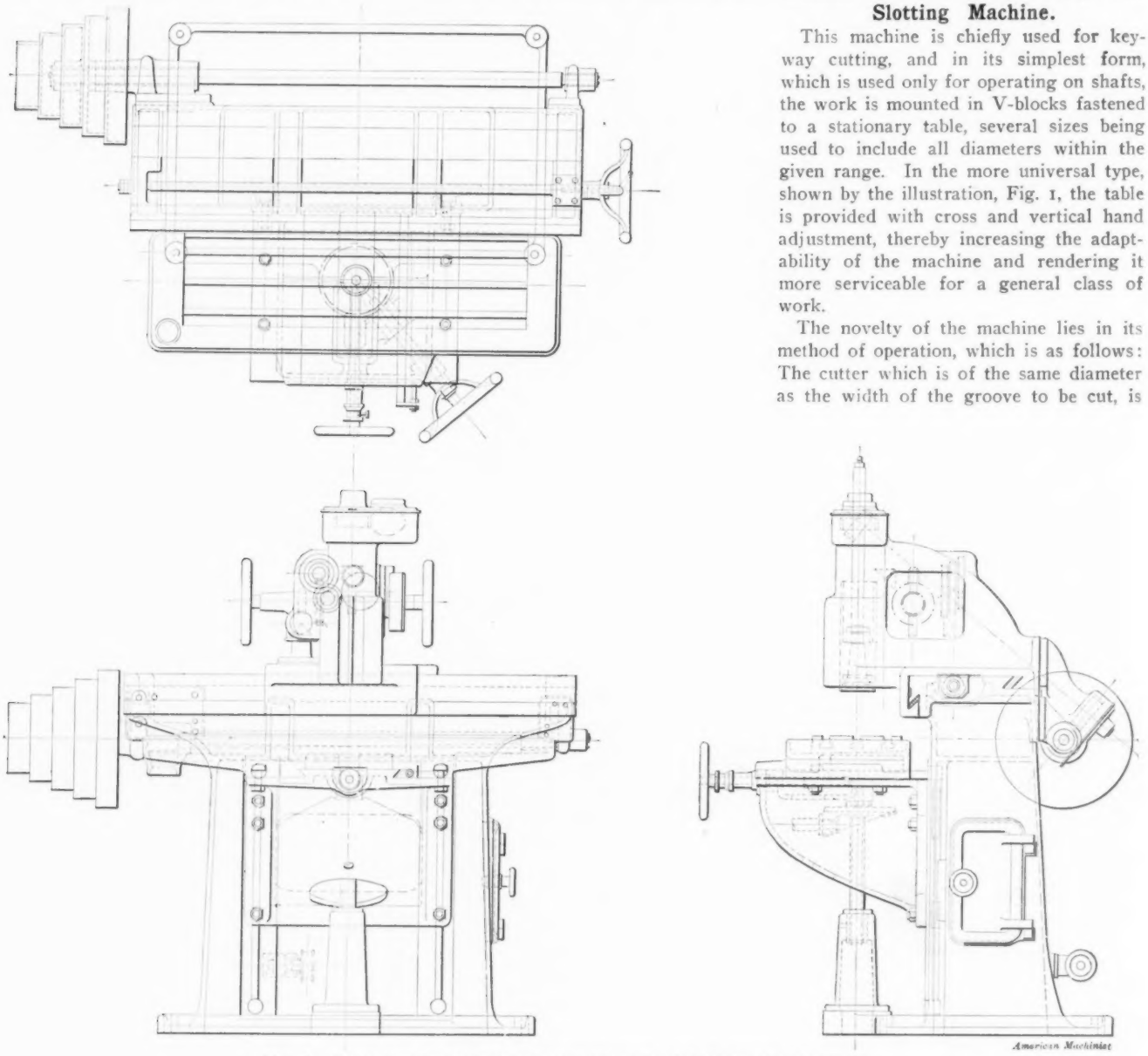


FIG. 1. PLAN AND ELEVATIONS OF KEYSEATING AND SLOTTING MACHINE.

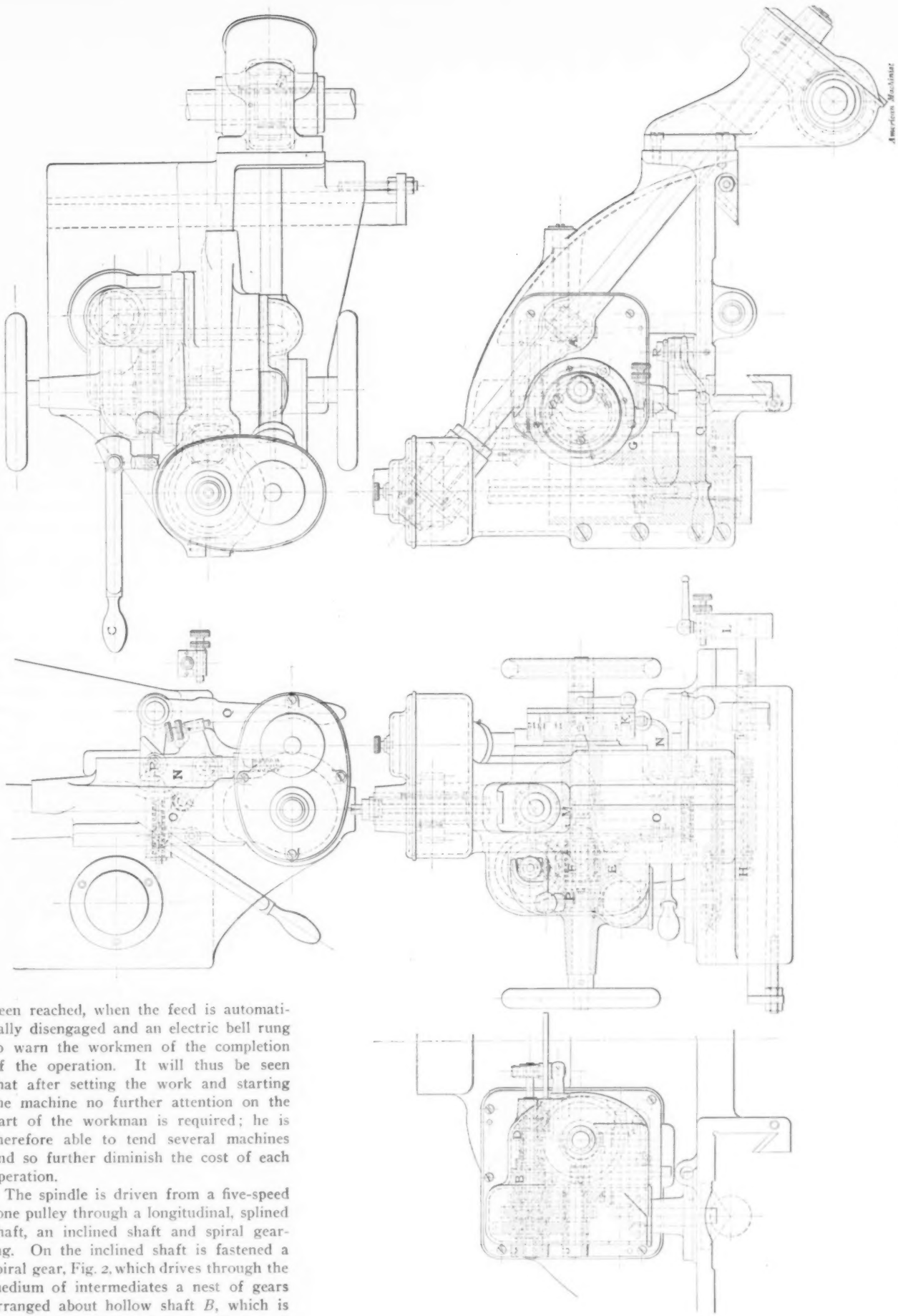


FIG. 2. KEYSEATING AND SLOTTING MACHINE HEAD.

been reached, when the feed is automatically disengaged and an electric bell rung to warn the workmen of the completion of the operation. It will thus be seen that after setting the work and starting the machine no further attention on the part of the workman is required; he is therefore able to tend several machines and so further diminish the cost of each operation.

The spindle is driven from a five-speed cone pulley through a longitudinal, splined shaft, an inclined shaft and spiral gearing. On the inclined shaft is fastened a spiral gear, Fig. 2, which drives through the medium of intermediates a nest of gears arranged about hollow shaft *B*, which is fitted with a sliding key for change of

feed, this change being effected by hand lever *C*. A worm *D*, which is keyed to the hollow shaft, engages with a worm wheel *E*, driving a sliding, double clutch *F* for rotating through suitable gearing the screw *G* for vertical feed, and the rotating nut *H* on the fixed longitudinal screw in the bed for horizontal feed.

Keyed to the same shaft as the clutch for vertical movement is a small pinion *I*, which engages with an internal gear rotating freely on a boss of the casting and encircled by an index plate which can be clamped to the internal wheel by screw *K* for regulating the depth of the slot. The longitudinal traverse is defined by a stop *L*, carrying a scale adjustable along the bed in connection with a fixed pointer on the carriage. Before starting the machine, the required depth and length of the slot (the latter being measured from center to center, *i. e.*, the total length less the diameter of the cutter) are read off on the index plate and stop respectively, which are then tightened in place and the sliding clutch is thrown into gear with *M* for starting the vertical feed.

When the cutter has been fed to the necessary depth the stop on the index plate strikes against a corresponding one on lever *N*, which is coupled to the clutch fork by lever O, thus throwing the clutch out of gear with *M* and into mesh with *P*, thereby disengaging the vertical and putting the horizontal feed into action.

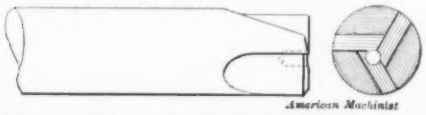


FIG. 3. CUTTER FOR KEYSEATING AND SLOTTING MACHINE.

When the carriage reaches the end of its stroke the stop on the bed strikes lever *Q*, which by means of pin *R* and lever *N* throws the clutch out of gear. The connection between levers *Q* and *N* is so arranged that the clutch, after the vertical feed has been disengaged, is free to slide into gear with *P* for horizontal traverse, but after being again knocked off it remains in its central position and is prevented from again engaging with *M*. Hand levers for engaging or disengaging the feed motions are provided, as are also hand wheels for fine vertical and horizontal adjustments of the cutter. The latter, as shown in Fig. 3, takes the form of a flat-bottomed drill with three cutting edges, the clearance hole being drilled eccentrically, thus avoiding a tit at the center and leaving the hole perfectly flat at the bottom and free to start milling in the horizontal direction. The cutter is driven by a socket in the spindle by means of a tang, as is usually the case with twist drills. This socket is keyed to the spindle and drawn up in place by a long bolt passing through the latter and provided with a square head at its upper end.

The machine is of rigid construction and well adapted for sustaining the heavy cuts taken. An idea of its capacity may be gained from the fact that a slot 5¾ inches long 1 inch wide and ⅜ inch deep has been cut with it in 6½ minutes. It is designed to be driven either by an overhead countershaft equipped with fast and loose pulleys or by a variable speed motor. A pump is provided for conveying the lubricant to the cutter, and the table and base are surrounded by water channels.

The machine is built in two sizes, one for slots up to 1 inch wide, ⅜ inch deep and 32 inches long, and the other for slots up to 2 inches wide, ⅝ inch deep and 40 inches long. The weight of the smaller machine is about 3,200 pounds. The builders are de Fries & Co., Ltd., Heerdt, near Düsseldorf, Germany.

Echoes From the Oil Country—Old and New Machinists.

We all know, from hearsay, that the machinist of former days was in every way superior to the machinist of to-day. When a boy starts into a machine shop he may find that the men do not seem to be very much interested in teaching him how to become a good mechanic, but he will always find the man who will see to it that he shall understand that the machinists of old had a skill which is fast dying out. Even among well-informed people it has come to be a proverb, and you know "what everybody says must be true."

To some of the latter-day mechanics it might be interesting to get a glimpse of one of those old-time lords of the trade, for while it might be presumptuous to try to eclipse their record it might be of interest to know from what high things we have fallen. You will understand that I am not speaking of the genius who may be found, once in a generation perhaps, who may seem fitted by nature to do things that training only helps to do but does not prevent from working in original ways.

Even in the old days it sometimes happened that things went wrong, and one day the superintendent of a plant found a job back on his hands because it was claimed the man had not worked to the sample furnished.

"See here, Bill, I told you you must work close on that job and now it is back again." The superintendent has fire in his eye and Bill has his reputation at stake.

"Yes sir, yes sir; so you did, and I did as you told me, too. I can work to a hundredth of an inch if the job actually requires it. I don't do it for every job because fine work is expensive, but I always work to a scant sixty-fourth on any job that needs to be close, and I did better than that on this one." Bill felt that modesty should not make him keep his light under a bushel on such an occasion.

"Hundredths and scant sixty-fourths," growled the superintendent contemptuously. "Better say eighths and quarters. It makes me mad to hear you fellows talk just as if you knew what good work is. When I was young and learned my trade a fellow had to learn it. My old master was a man who could not be beat in the country, and he made me do every job right, no matter how long it took me to do it. Now, all you fellows think of is to get a job out of your hands, no matter how it is done. Why I have spent more time scraping a valve and seat together than lots of shops nowadays spend in boring and fitting up the entire cylinder. When a man got one of those old jobs he paid a good round price for it, and he took good care of it, and he had something that would last. There is no use of talking, I suppose, but I don't know what the world is coming to, or what they are going to do by and by for real mechanics. You put this piece in right away and take off a hair, and, mind you, only a hair. Don't file the bearings too much because some men don't know enough to watch a new job till they get a bearing."

As Bill was one of those old-time mechanics for whom the present world is longing it is safe to presume that he got the "hair" off if he was given sufficient time.

Bill was an "all-around" mechanic.

Perhaps some of you young fellows do not know what an all-around mechanic is. I will try to tell you some of the things Bill could do. He could chip and file and scrape. He could chip a flat surface and file it and scrape it, and when it was done it was nearly as good as you can do with a planer. He could do as much of it in seventeen hours as you can do in forty-five minutes, and once in a while he could chip and file in a place where a planer cannot work at all. He could cut threads with a hand die that would be straight enough to allow the nut to come up square—if left a nice easy fit. He could set a valve so that the engine was nearly sure to run without the valve having to be moved. That is, he could get it so that it would turn over, and then by listening to the exhaust he could put the finishing touches on it. He could go out into the country and make a steam or water joint with anything from an old hat to a piece of bacon skin. He could take a piece of steel and flatten it out and put a lip on it and grind it up into a drill "five-eighths and a sixteenth, and a scant sixty-fourth" in diameter. Then he could temper it and drill a hole of unknown diameter and worse than unknown shape. He could build up a wonderful collection of blocking under a piece on the planer and nibble off a little metal without having the whole thing on the floor every time. He could run any lathe in the shop from the 14-inch one to the mammoth 28-inch one that had a bed 16 feet long. He could carry iron in the foundry nearly as well as a regular foundry helper, and by using his jackknife and a file he could make a pattern that could nearly always be pulled from the sand if it would stand the rapping without going to pieces. He was not very bad at carpentering, either—that is, such carpentering as comes around a machine shop.

His blacksmithing was away ahead of no blacksmithing at all, and he wasn't afraid of a soldering-iron, either.

These are not all of Bill's accomplishments, but will serve to show that the title of being an all-around man was not altogether undeserved. The number of the jobs that came along was not much larger than the variety, and every job had to be done "somehow." Bill was ready for them. It is surprising how poor a job will pass when it is a choice between it and no job at all, and how very particular people will get to be when there are dozens of places ready to do the work. If Bill should come dropping in just as you are lamenting the lack of the good old all-round mechanic of former days, I wonder if you would give him a job, and if you did, I wonder what you would put him at and how long you would keep him.

Perhaps a glimpse of a shop of to-day may seem more real to some of you.

"There is some dispute about sizes, and I would like to have you come out with the large micrometer and decide it." One of the foremen had a misunderstanding with another one as to whether a certain fit was as it should be. The pieces in question were turned to snap gage. They were to fit into babbitted bearings, and there was no doubt about there being differences in size. The question was as to the amount of the differences, and whether they would do any harm. A careful examination of one shaft that seemed to show more than ordinary difference showed a variation that did not exceed a quarter of a thousandth. It was that much under the "feel" which the lathe man was supposed to get with the snap gage. It was the lack of this feel that had raised the question. The large micrometer used did not read finer than thousandths, so that anything finer than that had to be estimated. In some sizes which are common two gages of the same size are used, and it is no uncommon thing to find the men detecting differences of feel in a pair when it is not enough to be detected by a measurable movement of the micrometer.

If a man who feels disposed to find fault with modern workmen will perform a few simple experiments, he may begin to realize how close modern work really is. An end measuring rod such as made by the Brown & Sharpe Manufacturing Company and a snap gage of the same size are all that is needed. The sizes can be anything, but from 3 to 6 inches are perhaps the most convenient. After letting the pair lie until both are of the same temperature, say 70 degrees, try them together with as little handling as possible and note the feel. Lay the snap gage down and hold the rod in the hand for a few seconds and then try them together again. The feel is very much harder. Lay the rod down and hold the snap gage in the hand, and on trying again it may be found that the feel is gone entirely. After you have tried to measure with a micrometer to find how much, or how little, rather, a very distinct "feel" really is, it may be possible that you will have more of a feeling of respect for the man who is working to within a "feel" with snap gages, and while you are about it, kindly remember that he is working under numerous conditions that are not favorable for the closest of measuring. His tools heat his work and he hasn't time to let it cool before measuring it. His hands heat his gage, but he must handle it to use it. The temperature of the room in which he does his work is beyond his control, but it may influence the results. He must always have before his eyes the "time" on the job. Manufacturing establishments are built and run on time.

"I have a few things here I want to call your attention to. They are places where I think we can do the work a little better. I would like to get things to the place where I would never have to do it. Do you suppose I ever will?" The superintendent is opening up on a foreman.

"I've been thinking of that very thing myself very often, and it may be I look at it a little differently from you. I wonder if the time will ever come when you will be satisfied with the work as we do it?" replied the foreman. He had been with the firm for years. "You would take my head right off if I let work go now that we used to think was mighty good work. We used to think it was doing good work if a piece fit one hole right, and now you expect every piece to fit every hole, and 'holler' if you find a bored hole is taper a half a thousandth or varies twice that from any of the others. Take that keyway job for a sample. It is expected that the gage will not vary more than an eighth of an inch in the place where it will stop. It measures from the opposite side of the hole, and cannot be tried while the work is in the machine and the keyway is being cut. The taper is an eighth of an inch to the foot, or an inch in ninety-six inches, so that a difference of an eighth in the stopping place is not so very much more than a thousandth variation; and yet you would like to cut *any* variation out. Some iron is softer than others, and some cutters are sharper than others; and if a man averages more than ten minutes to the piece he is considered 'slow,' and so he is. We used to think a man who could cut one of these keyways in by hand in an hour and a half was a mightly good man, and when he got it done in that time it did not begin to be as good as our worst ones are now. If you will quit raising on your ideas of how good you want the work you will not have to chase me so often."

The superintendent knew all of this to be true enough, but he also knew that the world that uses the things is also raising its standard, so that it was necessary for him and the foreman to resolve themselves into a committee of ways and means to at least keep up to the demands, or they would pass away with the other things which have changed because the world is finding better methods.

I have understood that James Watt had trouble in finding workmen who could do his work properly. I never heard that he lacked material from which to make them. Every man who is advancing beyond present practise finds himself to some extent in the same position if he needs much help, but if he himself is smart enough to do that which he wants done he will find plenty of material near at hand that also can be trained to do it. All he needs to do is to make a good selection, prove that it pays the material as well as himself to go through with the training, and then have patience.

If any man who is not in the mechanical world repeats to you the old newspaper cry that it is hard to find men nowadays who understand their business, tell him that it may be so among the class that he represents, but that it is not so when applied to the mechanical world, and you can easily prove it to him. With the whole world being run by machinery, and mighty good machinery, too, it can readily be seen that the smartest men in the world are making it. They may not be of the same type as Bill of the olden days, but they fill their places just as well as he did his; and when they, in turn, have been displaced by other methods, the next generation will have some among them with the same old lament: "You can't find men any more who have really learned their trade."

Brother machinists, we are better read, have more knowledge of mechanics and have more skill of the kind that the world wants and is willing to pay for to-day than we ever had before, and to-morrow we are going to have more of all of these things than we have to-day. Our number has increased so that there are a dozen now where once there was one. There are those among us who should be at something else, just as there were among those in the days when Bill was the type of man that was needed; and you will always find some of that kind in every calling until the end of time, but for all of these things do not allow to pass unchallenged any statement you hear to the effect that as a class you are degenerating. It is not true of machinists as a class, and unless you are one of the class who should be hoeing corn instead of working in a machine shop, it is not true of you as an individual.

When you are dead and gone and your place is filled by a man of a different kind, who is doing things in another way and with machines not now known, people will clothe your memory with virtues beyond what you have deserved, while in the flesh you allow all sorts of people to slander you. Brace up. W. Osborne.

Letters to the Editor.

Indicating Machinists' Dimensions on Drawings.

Referring to the communication by Mr. Falardean, at page 561, I desire to say that I am much interested in the indicating on blueprints of the machinist's figures as distinguished from those for the patternmaker.

It seems as though this was a most excellent plan. There are in any ordinary casting a large number of measurements required by the patternmaker in order that he may properly construct the pattern. Sometimes but a small percentage of these figures have any direct interest to the machinist, only certain portions of the casting needing to be fitted up and certain lengths and sizes to be accurately obtained.

If there is no distinguishing mark in regard to these different dimensions, it is either necessary to have separate prints, which means separate tracings—one for the patternmaker with all dimensions and one with just the dimensions for the machinist—or else the machinist must make constant inquiry from the foreman or the drawing room as to which dimensions he needs to make note of and obtain in the finished piece.

Mr. Falardean states that these indicating marks are not necessary with dimensions of steel parts or in the case of castings that are to be finished all over. This, it seems to me, is a mistake because in the case of a forging there might be certain portions which would not require machining and those dimensions could be considered exactly the same as the dimensions for the patternmaker on an ordinary casting, and it would be of value to have the dimensions shown, although the machinist would not have to work to them. The same tracing or print would then answer to send to the blacksmith or the drop-forge people from which to make dies, and the machinist would finish only wherever required as shown by the indicating marks.

Moreover, I believe that after adopting a certain system, it should be adhered to throughout, and if a sheet contains drawings for both gray-iron and steel parts and the drawing for the gray-iron parts has the distinguishing marks for the machinist, the other piece ought to have the same or there will be a question raised in the mind of the workman as to why one drawing has the marks and the other has not; and furthermore, if on the steel parts there should be some dimensions which were not of great importance, like the outline of a forging or a portion made smaller for clearance only, their lesser importance could be indicated by leaving off the distinguishing marks which would correspond to the patternmaker's figures on the parts to be made of gray iron.

This system is in use in the works where I am in charge, and it has been found to answer a great number of questions before they are asked. There may be some other method superior to this; if so, I hope that it will be shown up by some of the readers of the paper.

NICHOLS.

Renewal of a 30-Ton Marine Crankshaft.

Before the days of combines and rate wars had affected the steamship companies who carried on the Atlantic passenger trade, it was the practise of the firm—to which the following relates—to keep one steamer as a stand-by or relief ship, so that in the event of a breakdown occurring, or the semi-annual drydocking of the other ships, she was always ready to have steam raised and fill the gap at short notice.

But the sale of the old ship and consequent changes in affairs made it necessary that the following repairs or alterations should not, if possible, interrupt the weekly sailings of the four remaining ships, and as these alterations took place on two of the ships on the New York route, the whole may be classed as a rather smart engineering feat.

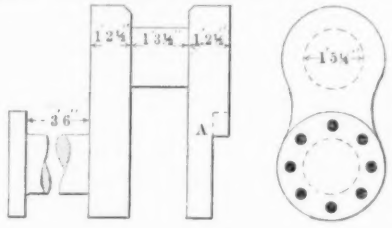


FIG. 1.

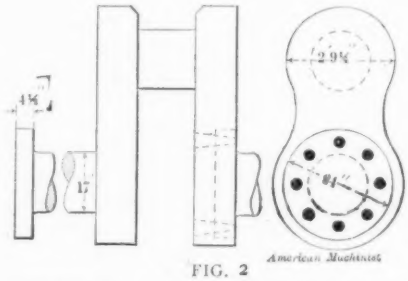


FIG. 2

RENEWAL OF A 30-TON MARINE CRANKSHAFT.

The ships to which I allude were twin-screw, of about 12,000 tons and also of 12,000 indicated horse-power, quadruple expansion inverted type of engines, with four cranks to each engine and Walschaert's single eccentric valve gear. As the firm had information that a ship with a similar design of crank, although much smaller in dimensions, had begun to develop serious flaws in her crank webs, it was decided to renew the faulty webs and substitute others of different construction.

The old cranks were of the shape shown in Fig. 1 and their weakest place was as shown at *A*, which is a recess in the web for the reception of the flange coupling of the next crank, thereby reducing the web considerably. Templets were made for the setting of the eccentrics and their keyways and the work of constructing a new shaft and altering the other four was entrusted to a German firm. The first ship, "M," arrived on the Monday at 5.30 P. M., and a gang of carpenters proceeded at once to shore up the engine room platforms, ready to receive the excessive weights which would be laid upon them, and immediately the telegraphs rang out "Finished with engines," the shore staff of machinists began to strip the starboard engine, taking down all the gratings, oil pipes, steam pipes and taking off the four connecting rods, eccentric rods and pulleys and main bearing brasses and caps. The eccentric pulleys were to be keyed on to the new shaft which was lying on the quay, and the old shaft was to go away to have the faulty webs replaced by new ones of the type shown in Fig. 2. The improved shaft would be put aboard the ship "H," which would arrive a fortnight later, and the shaft taken from the latter ship would then be altered and wait for the ship "M," whose port shaft this time would go into the ship "H," whose last shaft would be altered and placed in the store.

This, then, was the program mapped out by the company, and had not to interfere with the loading and unloading of the ships at the company's wharf, nor interrupt the weekly sailings. The work proceeded day and night, and 8 o'clock on the Tuesday morning found the starboard engine stripped, rods, bearings, eccentrics, pulleys and straps all lying on the floor plates, the four cranks uncoupled and one of them ashore. Of course all the cranks had to be put ashore before the new cranks could be lowered into the engine room. The means adopted for this handling was a temporary derrick, rigged up on the boat deck and worked by guy ropes from the ship's own winches running through snatch blocks rigged up in convenient places aboard and ashore, as it was impossible to get under a crane. The shore staff was composed of twelve marine engineers of different nationalities and three helpers per engineer. They all worked the first night with two of the ship's engineers standing by to turn the engines. At 8 A. M. one-half of the men knocked off and came back on the Tuesday evening as a night squad. At 5 P. M. three cranks were on the quay, and by 9 P. M. the last one went over the side. Alinement of the bearings was next tried and found to be correct. At midnight the first of the new cranks was swung aboard, dropped temporarily into place, and as the others followed, adjustment of eccentric pulleys was proceeded with. By 2 P. M., Wednesday, all the cranks were down. Now commenced the assembling of the parts, and the crankshaft was coupled together. As the tapered coupling bolts went in from the inside of the webs, they

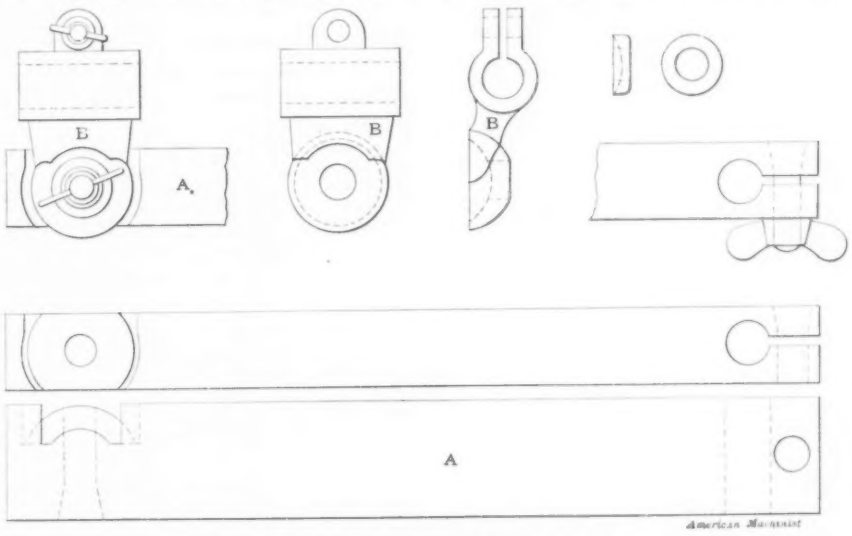
had all to be forced home by hydraulic jacks. After the cranks were connected—with the exception of the thrust coupling, which was only coupled by temporary bolts to admit of turning—the connecting rods were adjusted to their respective crossheads, which was a cramped and tedious task, as the front columns were square section gray-iron columns and carried the guide bars. By midnight the rods were all swung and the adjustment of main bearings and bottom ends proceeded with; these were finished about 10 A. M., Thursday. It was found necessary to ream the bolt holes in the thrust shaft coupling and fit new bolts, of which there were eight with a body 9 inches long and tapered from 5 inches to 3¼ inches diameter. In the meantime the refitting of the eccentric straps and rods had been going forward, and after all were connected and the bolts fitted, the engines were centered top and bottom for valve adjustment. The valves—three piston and two double ported slide, the latter belonging to the low pressure—were set to correct leads, and by 7 P. M. the engines were ready to undergo steam trials, which took place at 7 A. M., Friday. The engines were run easily for four hours in the presence of an anxious group of superintendents, ship's engineers, foremen and machinists without a hitch, and everyone felt thoroughly satisfied with the work. It will be seen from the foregoing that the time taken from start to finish occupied about seventy-three working hours, which might well have been longer, as the parts were necessarily very heavy; each crank weighing seven and a half tons, and awkward to swing in under the cylinders between columns, etc. The ship sailed at the usual time on Saturday, 10 A. M., and arrived in New York on time without any trouble or overheating of her working parts all the way across. After being so successful with the first, the remaining three came easier to the men, and all the shafts are now in their places and working satisfactorily. "MAC."

A Boring Tool and Indicator Holder.

I send you a sketch of a combination tool and indicator holder, which is an original idea, and is found to be a very useful article. It was really intended for a Starrett indicator holder, but it was found that with a few minor changes it could be converted into a tool holder as well, and it is far superior for that purpose to anything that I have seen.

A is a piece of tool steel 9-16x⅞ inch and 6 inches long. One end is reamed 5-16 inch for a tool for splining small holes, the clamp allowing the operator to adjust the tool so that only the length absolutely required is left projecting in advance of the holder. On the other end of the piece a ball joint is made on which is mounted a holder *B* for boring tools and for the indicator for testing tapers; also various other things. A good feature about the ball joint is that it allows one to so adjust the tool that it passes in straight with the hole, and not cocked up in the air, as is often the case with the ordinary holder, and therefore it permits the use of a rod that will nearly fill the hole, thus gaining much in the rigidity of the tool; it also allows considerable adjustment in various different ways, which is sometimes very convenient.

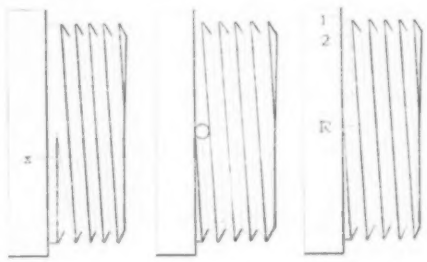
The saddle piece or holder *B* should be reamed the same size as the hole in the other end of the tool holder, which in this case is 5-16 inch, and it is provided with a thumb-screw, which allows the user to shorten the rod as much as possible, and also to get the proper rake on the tool. A series of bushings is made for various sizes of rods as may be needed; in most cases two or three would be sufficient; 3-16x¼ inch is more desirable for the average indicator. The bushing is split on one side, the slot being placed so as to coincide with that of the holder, allowing the clamp to tighten firmly upon the rod. The rods should be made the proper length to be used in either end of the holder, and should have a slight shoulder on one end so as to prevent all chance of slipping. This furnishes an indicator holder that will hold the indicator either horizontal or vertical, as the case may require. O. D. STORES.



A BORING TOOL AND INDICATOR HOLDER.

The Use of the Compound Rest in Thread Cutting

It was with much interest that I read the recent articles by Professor Sweet. In closing one of them he stated that in thread cutting some remarkable results might be accomplished by setting over the compound rest. I, and no doubt many other readers, regret that he did not give an extended explanation of the method referred to, and hence I will ask you to allow me space to present a limited experience with it



THE COMPOUND REST IN THREAD CUTTING.

In Fig. 1 is shown a piece to threaded. "Run the thread just as close to the shoulder as you can," are the instructions given. The closeness with different machinists varies largely when the compound rest is not used. The feed being at a right angle with the axis of the work, and the tool needing a certain amount of space to be withdrawn in, so that its point may not break, the distance of the tool from the shoulder at the completion of the thread may vary anywhere from point *x* to *y*, depending on the skill of the workman.

Sometimes the piece is first drilled, as shown in Fig. 2, to allow the tool to stop at the shoulder without breakage. Now notice the results obtained by setting over the compound rest to an angle of 30 degrees, running the lower cross-slide against a stop after every withdrawal of the tool, feeding in only with the upper slide. The tool will cut a full thread up to the shoulder without breakage, and, moreover, clearance is gained beyond the line of thread fullness.

Many who are not familiar with this method will say that such a thing is impossible. Fig. 3 shows how this seemingly strange result is accomplished. The first stop of the tool is at point 1, the next at point 2, and so on until the thread is finished at point 12, giving a full thread up to the shoulder and clearance beyond, so that if the nut is properly chamfered out the threaded piece will screw up to the shoulder. In addition to the quickness possible, this method accomplishes results that are highly pleasing to the man who appreciates good work, cutting clean threads, free from chatter and raggedness.

Why is not this method more generally known and practised? Why are machinists compelled to use lathes without the compound rest? Why are handles of small radius, less than two inches, placed on lathes otherwise seemingly well designed? Decent threads cannot be cut in any reasonable time on such lathes. Fine workmen will continue to lose good records when compelled to work on such lathes.

F. RATTEK.

Cutter Grinding in Small-Arms Plants.

About the year 1885 I was in the employ of a small-arms manufacturer in Connecticut, and my duties consisted of grinding and adjusting cutters for Lincoln and hand milling machines.

The cutters were all of the regulation gun-shop type, and to grind them free-hand was quite a task; not so much in keeping the shape as in keeping the clearance right, and it was a very easy matter to get back on the heel so far as to remove the edge of the next tooth.

One day a man appeared on the scene with the rig described by W. E. Stern at page 558, and solicited an order. Our management was promptly informed that that was the most needed tool in our shop just then, so the order was given and the tool installed in due time, and to say that it was a success would be putting it mildly; it took care of the clearance and insured all of the teeth having the same amount, and it enabled the operator to give all of his attention to the shape. We made a shaft with a taper hole in the end and ground irregular profiling cutters with fine success.

The last time I saw this particular tool it was lying on the floor of a shop in Greater New York, detached from the pipe by which it had been suspended from the ceiling, and I doubt if anyone there knew what it was for. The man who sold us the tool was foreman of the milling job at the Parker gun shops at Meriden, and he informed us that he originated and had used the device for several years and it seemed so good he had decided to put it on the market.

It will no doubt surprise many readers of the AMERICAN MACHINIST to learn that form mills, so-called, are used but little if at all in the gun and pistol shops for the reason that the scheme does not work out on a gang of mills six or eight inches long, such as are used for cuts on receivers and trigger straps.

When work is milled to receiving gages the mills must be just right, and with form mills the distortion caused by tempering is enough to make them wrong, and there is no remedy, as the surfaces are too large to stone.

I worked in one shop where the gage cuts were finished by a very light second cut, the mills being cut very coarse—in some cases as much as an inch from face to face of the teeth—and run at high speed. The small number of teeth made the mills easy to stone, and they would turn out many thousands of pieces with one sharpening.

Shaped cutters for stirrups and sears and for limb work with curves too small to grind, were drawn to a purple and sharpened with a scraper.

A very good scheme is to mill a strip of tool steel with a gang of cutters which have been properly adjusted, and mill three or four teeth in the formed edge, which backed off and tempered makes practically a straight mill in reverse. This is laid away until such time as the gang of cutters is to be made over, when they are annealed, placed on the arbor and the form run under, taking several light cuts until the mills are entirely re-formed; they are then re-cut, backed off and tempered, making practically a new set.

THEODORE.

The writer of an article under the above title, at page 558, says he would like to hear from someone actively engaged in using the cutters employed on small-arms parts as to their advantages over the formed type so nearly universally employed.

I do not happen to be so engaged, but have interviewed those that have used and made them at the Springfield armory. The advantages claimed are numerous. The formed type of cutter, as generally made, has about one-half or one-third the number of teeth that the other style has; this means that a more rapid feed can be used with the cutter having the greater number of teeth, allowing that a tooth on this style of cutter will remove as much stock as a formed cutter. I do not mean that the number of teeth should be carried to such an extreme as not to allow for chips, etc.

Formed cutters were tried on this class of work at one time, and it was found that these would not last as long as one of the other style. This was accounted for by the fact that when a cutter becomes dull it requires but little grinding on the circumference to sharpen it, but would require considerable grinding on the face or radial line of the teeth. It was also found that the formed cutters would not leave the work as smooth as the other style; they seemed to drag as tho they were not backed off at all. The formed cutters which were tried were made by a leading manufacturer, who makes a specialty of milling tools, etc.; so it cannot be said that they were not properly made.

The strongest argument, I think, that can be advanced is that if a straight cutter is used no one thinks of using a formed cutter and grinding it on the face of the tooth, but prefers to grind the tooth on the top, and as this can be done with any form of cutter, why should this not be considered the best way?

JOHN H. SULLIVAN.

Making Drawings That Will Not be Misunderstood.

The drawing, Fig. 1, page 497 (with note at page 533) is right, and there should be no excuse for an up-to-date machinist making the mistake shown in Fig. 2. The shaded surfaces on Fig. 1 could mean but one thing and that as intended. While it is general practise to use the third angle of projection instead of the first, as shown, the first angle is allowable where views are consistent as they were in Fig. 1.

While it might be an advantage to have the finish given, if any, aside from the threaded part, and an over-all length, it very often happens that the finish is known, and only sizes are needed.

Now, if the piece was made wrong with the drawing as per Fig. 1, what an excellent opportunity for more mistakes with the drawing like Fig. 3, where we have no dimensions given to limit the length of any part, to say nothing of an over-all dimension.

When two views are given it is not necessary or customary to use the contraction *"dia."* as diameters are self-evident then; it is also waste of time to show three dimensions (⅜") where one would do, while one dimension would be saved in regular practise by adding "sq." to the 1-inch dimension and omitting the other. In short, of the seven dimensions used, three are unnecessary, while five are omitted that are important.

D. RAFTSMAN.

Making Drawings That Will Not Be Misunderstood—Jig Drawings.

Under the above title S. A. Moss at page 497 shows some drawings of a square head stud. The average draftsman knows that the third angle is the accepted method of projection and the average machinist knows that that means the end or side nearest the projection is shown. The drawings in question are turned up from the far side and, while this may be the custom in West Lynn, I have not found it the custom in any of the many shops I have visited between Hartford, Conn., and the Mississippi river.

There was good reason for the boy writing on his picture "This is a cow," but I can't see any for putting the word "diameter" on a two-view drawing of a round stud. And why write "across flats" in long hand after putting it on in short hand that is understood by every mechanic?

I read in a recent issue of the AMERICAN MACHINIST of the practise of making tool drawings on buff paper and varnishing for use in the toolroom, and I don't think it just the thing for an up-to-date high-speed shop.

I know of one large concern which employs about 150 toolmakers and puts jigs and fixtures through in remarkably quick time, and the drawings are quite a part of the system. The piece of work is

drawn and red inked and the jig or fixture constructed around it, no more views being shown than are necessary for clearness. A tracing is then made showing the work in red ink, and two sheets of details are traced from the original drawing, one for the patternmaker and one for the smith. Blueprints are not made, as the tools are seldom duplicated.

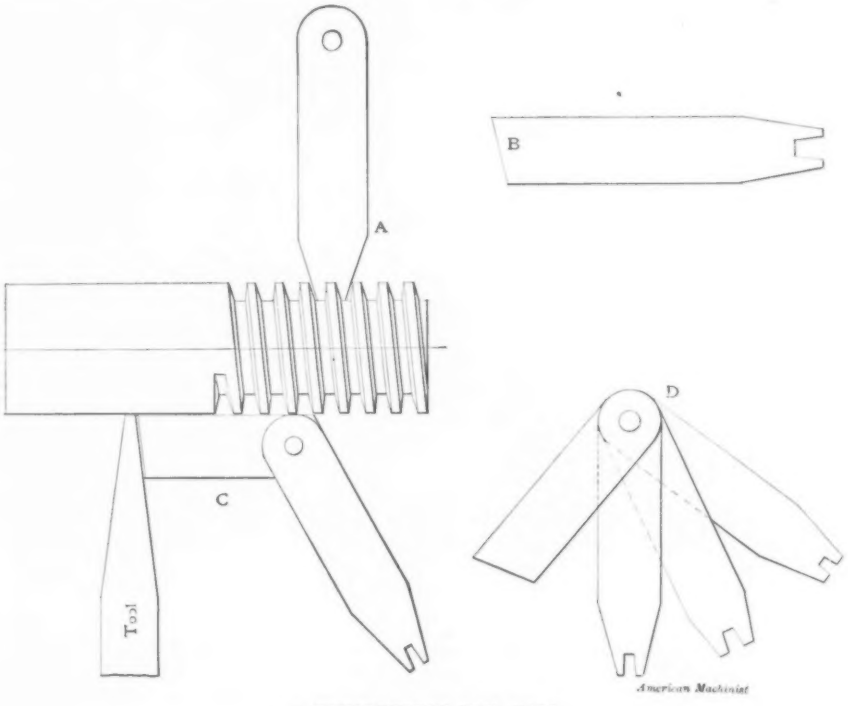
When the drawings are finished and O.K.'d, a clerk writes the orders for the smith and patternmaker and sends to each an order with his sheet of details, and when the patterns are delivered he orders the castings, the patterns being subjected to inspection by the head draftsman and head toolmaker before being sent to the foundry. When the castings and forgings are received in the toolroom they are sent to the planer or milling machines, as the case may be, with the detail sheets only, and machined.

The head toolmaker now collects as far as possible all the material required on the job and turns it over with the construction drawing to one of his men, who has only to fit and screw together and put in feet and bushings.

This system brings lost time and false moves down to a very fine point and is, I think, an improvement on the single varnished drawing. THEODORE.

A Worm-Thread Tool Gage.

I send sketch of a form of worm-thread gage that I have found much more convenient than the usual circular style. It



A WORM-THREAD TOOL GAGE.

not only serves to grind the tool to the proper shape, but by placing it, as at *A*, on the worm that is being cut, it shows exactly when the thread is the proper length.

One end, *B*, may be made the proper angle for setting the tool to the work, or a number of different pitches may be fastened together, as at *C* and *D*, with a separate gage for setting the tool.

I regret that this form of gage is not on the market, but any machinist with a little care can make them accurate enough for all ordinary purposes. E. L. F.

A Micrometer Caliper — Keyseating a Spider — An Inserted Tooth Cutter.

I am pleased to see that there are others who have gone to the trouble to make

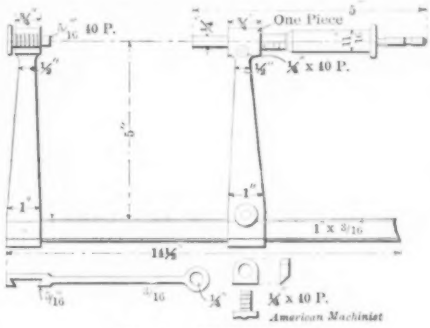


FIG. 1. MICROMETER.

micrometers and I enclose a sketch, Fig. 1, of a pair of 10x12-inch I made in 1898; there are but a few parts and these are very easily made. With the standard gages 3, 5, 7, 9 and 11 inches, you can set at any place. I made mine from one end to the other complete. I don't remember whether you could get micrometer heads when I made this or not, but I set to work and made tools for the job. The beam is of tool steel (not annealed) and all screws are hardened.

In small shops a man runs across some rush jobs. We had one the other day which was wanted as soon as possible. It was in connection with a sand drier drum supported on four spiders on a 2 15-16 inch shaft 20 feet long; three of these spiders had arms broken beyond repair, hence there was a call for three new ones 36 inches diameter. The —— Manufacturing Company had the original spider pattern, so I went over to pick it out, ordered three new ones cast and asked them to bore them for us; we could cast them, but our lathe would swing only 30 inches. We got the castings, and as the time was short I decided to bore and keyseat them, and made good time on the job. I rigged up my 25-inch drill and shoved a cutter down through and removed about 5-16 inch of metal in two cuts in 45 minutes.

Then came the job of keyseating 5/8x 5-16 inch with no keyseater. A cutter was rigged up for the drill spindle and in about the time it takes to tell it I was keyseating those spiders by working the lever. The

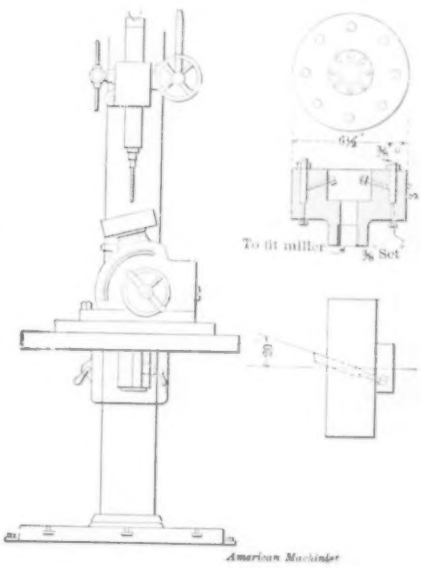


FIG. 2. INSERTED TOOTH CUTTER.

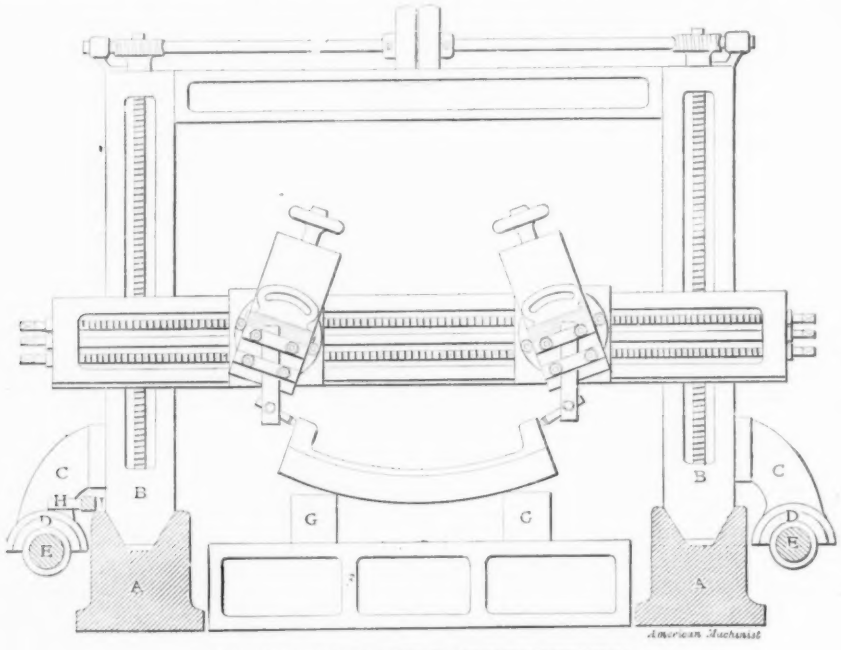
actual time of cutting was 15 minutes; setting and bolting down about 10 minutes.

Another job I ran across was a machine base and a pair of legs to be faced for it. The planer, 25x25"x5', would not take the work between the housings, so I resorted to a miller, but as I had no cutter an inserted tooth cutter was made as per Fig.2, and in about five hours the cutter was working on the legs of the machine.

The cutter blank, which was gray iron, was put on the dividing head and then under the drill all the holes for cutters and set-screws were drilled. The head was set over 20 degrees, so as to give the cutter rake. We cut 3-16 inch in gray iron 20 inches long in 20 minutes. Our miller is an old belt feed and we could not increase the surface speed. We were compelled to put the set-screws inside, as the housing for the overhanging arm projects out to the end of the spindle. The cutter diameter is 6½ inches. W. O. P.

A Large Planer With Traveling Housings.

The sketch shows the end elevation of a large planing machine in use at the Pagefield Iron Works, Wigan, England. It contains several points of interest, and is of a type seldom met with now. It was made about fifty years ago, but has been altered considerably during the past twenty years, and was originally in use at the Haigh Foundry, a large firm which flourished on the outskirts of Wigan in the middle of the last century, and I believe the builders of the great Laxey Wheel, Isle of Man. Looking at the sketch, it will be seen that the present-day planer practise is reversed, *i. e.*, the "table" stands still and the housings and cross-slide travel. This huge machine will plane 36 feet long and 12 feet 6 inches wide; the hight is almost unlimited, a pit being dug in the center to permit long work to be dropped down. The machine was formerly propelled by chains, I believe, but is now driven by a cross-shaft at the back end, carrying two bevel wheels, which drive two powerful screws *E*, one on each side of the machine, 6 inches diameter, with a square thread 3 inches pitch double lead. *A* shows the slides in action, and *B* are the housings, planed to slide in *A*, as shown. *C* are two gray-iron brackets, bolted to the sides of *B* and carrying two half-nuts *D*, 18½ inches long, made of hard bronze; these engage with the driving screws *E*, which propel the moving parts of the machine. *H* is a projecting catch fastened to *C*. *I* is a square rod, which carries two adjustable collars for working the reverse motion, and also the cross traverse by levers (not shown) which operate the two cross screws for working the two tool boxes, weighing 12½ hundredweight each, in first-class condition, and have power vertical feed, operated through the central splined cross-shaft. The cross-slide is raised and lowered by the pulley shown, driving the shaft with two worms on, engaging with the worm wheels on the end of the upright screws. The motion is smooth and powerful, the weight of the moving parts, including housings, cross-slide and two tool boxes, is 10 tons; the cutting speed is 20 feet, and the return 25 feet per minute.



A LARGE PLANER WITH TRAVELING HOUSINGS.

This machine works day and night, and will plane work of exceptionally large size and weight at a speed which would be hard to beat on some of the more modern tools; it will take an exceptionally heavy and broad cut without chatter. *F* shows the gray-iron ribbed girders, which are bolted to foundations, built about 10 feet apart along the inside of the machine standard. These girders have bolt holes cored in the top, to which the work is fastened, and also to the smaller gray-iron ribbed girders *G*, which are used for giving additional security to the work under heavy cuts.

The work shown on the machine is a typical example and consists of eight segments forming the rim of a larger rope-driving wheel, 24 feet diameter and 40 inches wide; these are all clamped in a row, as shown, and both ends are planed to the correct angle at the same time by the angular feed, thus ensuring every segment being the same size. These segments, so planed, go together nicely, and form a perfect rim without any chipping of the joints, as is sometimes necessary when the segments are planed separately on a smaller machine.

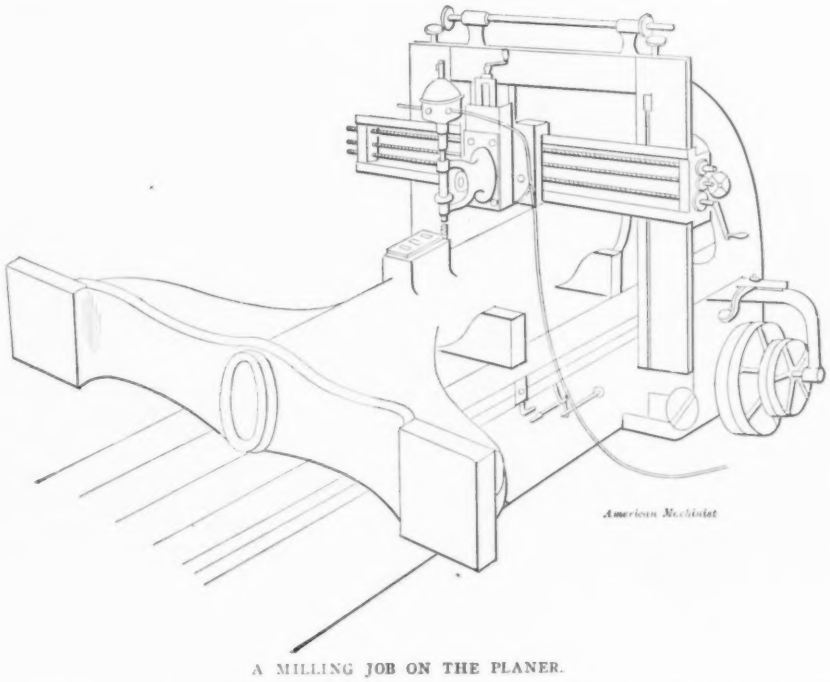
PAGEFIELD.

England.

[At page 567, Vol. 27, we illustrated a *modern* planer in which the rail travels, and the work is bolted to a stationary bed. —ED.]

A Milling Job on the Planer.

A few years ago it fell to my lot to devise a way to finish the valve seat of a large steam hammer. The seat formed the male part of the joint with the steam chest. The cylinder measured 16 feet across the feet and 12 feet long. The valve seat was 5 feet from each end and could not be reached with any of the machines in the shop except to finish the sides and top. The sketch needs but little explanation. It shows the cylinder on a 60-inch planer. The clapper box was removed and the vertical attachment of a milling machine substituted. A plug was fitted to the upper end of the spindle and turned stan-



A MILLING JOB ON THE PLANER.

dard taper to fit a large air drill, as shown. The air machine required no other support. A 2-inch face mill completed the outfit. To feed, the belt was pulled by hand and the other feeds were actuated by hand in the usual way, accomplishing a very good job in a short time.

A. S. MACKENZIE.

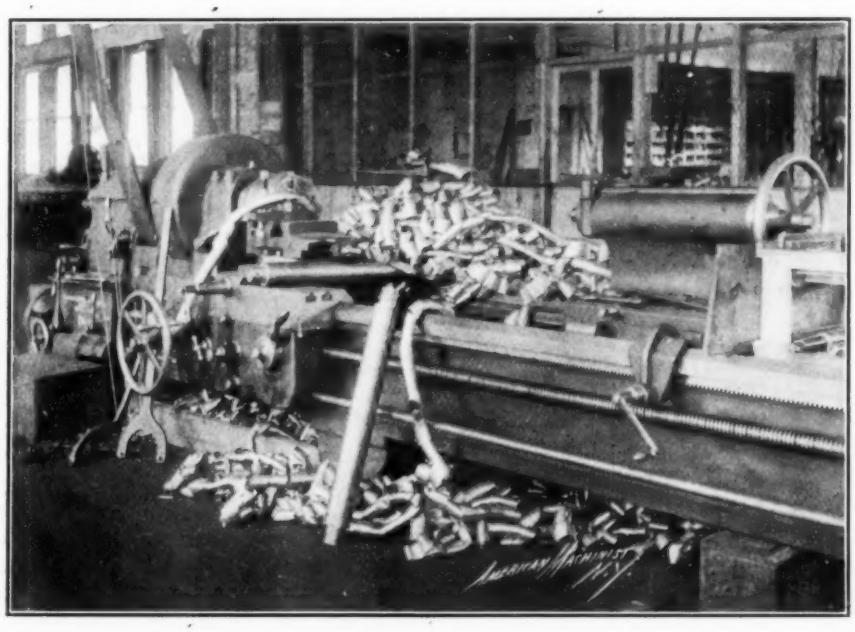
Machining Chord Pins for Bridge Work.

For bridge work a great many expansion rollers and chord pins have to be turned from rough stock necked down to take the separator bar and guide plate on rollers, and the nuts on the ends of chord pins.

The usual method is to cut the rough stock the desired lengths, center the ends and turn and finish on center.

The accompanying photograph shows this class of work done in a 30x4¼-inch hollow spindle lathe, 20-inch pulley, 8-inch belt and fitted with a special chuck, temporary motor drive.

In this method the rough stock is turned on centers in any multiple lengths within the capacity of the shafting lathe; it is then cut to the desired lengths and placed in the hollow spindle lathe. The outer end overhangs the special chuck the desired length to be operated on, the inner end being supported by a taper bushing in the hollow spindle.



MACHINING CHORD PINS FOR BRIDGE WORK.

The rollers shown in the photograph are 3 11-16 inches diameter, necked down to 2½ inches diameter—2⅜ and 2 9-16 inches long respectively, the cutting speed was 100 feet per minute in each case, the time was two minutes for necking down the 2⅜-inch width of cut with one corner of the tool cutting. Power to drive the lathe with this cut was 40 amperes 220 volts = about 11.9 horse-power. The time was also two minutes for necking down the 2 9-16-inch width of cut with both corners of the tool cutting. Power to drive the lathe with this cut was 50 amperes 220 volts = about 13.4 horse-power. A high-speed tool was used full width of cut and it ran for 24 to 28 hours without regrinding.

We tested the time to neck down to size on centers after the usual method, cutting speed 100 feet per minute. For necking down the 2⅜-inch width of cut the time was 13 minutes, and for 2 9-16-inch width of cut the time was 17 minutes.

Using carbon steel and a cutting speed of 25 feet per minute, the time was 52 and 68 minutes respectively.

The test of the power was taken to determine the size of a variable speed motor which we intend to place on this lathe; it seems we will require a 15 horse-power motor.

The special chuck apparently has sufficient gripping power to drive a 3 1-16-inch width of cut. A large amount of other special work can be done in like manner and to good advantage, and by removing the special chuck we still have a heavy 30-inch engine lathe and not a special tool held for a special class of work, although, of course, 30-inch lathes do not as a general rule have 4¼-inch hollow spindles.

C. D.

Nurling Button Dies.

In the sketch Fig. 1 shows a die, actual size, several thousands of which had to

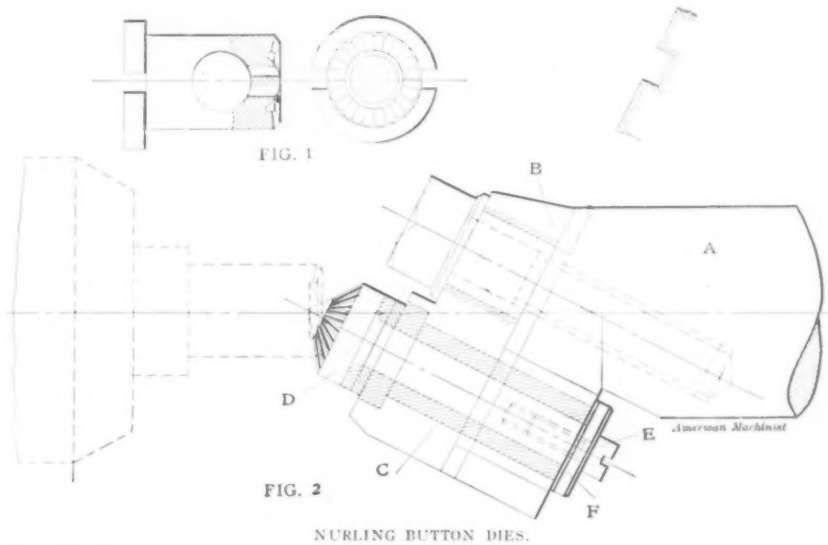


FIG. 1

FIG. 2

NURLING BUTTON DIES.

be made for a certain style of press for making buttons from a powder and when burned they become like glass.

There is nothing exceptional in the die itself, and with the exception of one operation there was nothing out of the ordinary in its manufacture. The exception referred to is in the way of forming the teeth on the end or face. This face was something like an internal or concave faced bevel gear, but with shallow V-teeth.

In filling a previous, though smaller, order each of these teeth had been shaped in a shaping machine, the die being held in a special fixture and divided by hand; but that process was altogether too slow for this larger job and it was decided to nurl the teeth in the lathe before cutting off. The dies being made of mild steel readily lent themselves to the idea and so the nurling tool Fig. 2 was designed.

This consists of a shank *A* held in the turret; slide *B*, secured to *A* and bored out to receive the hardened steel bush *C*; nurling roller *D*, free to revolve in the bush and kept in position by means of the screw *E* and washer *F*. The slide on the inclined face was for adjusting the position of the nurl radially to insure forming the required number of teeth in the die, and a slight alteration made a big difference in the number formed.

This being essentially an automatic screw machine or a turret lathe job, and the latter being considered the better of

the two, we decided to use it. After rough-turning the diameter and rough-forming the end, the nurl was brought into operation, a reasonable amount of pressure being exerted. The usual nurling-tool action partly raised the teeth and partly depressed the spaces, and by alternately using the nurl and the finish-form tool, two or three times each, an exceedingly good result was obtained—in fact better than with the previous shaping operation, for in shaping a slight burr was raised at the top of each tooth which had to be removed by hand.

The remaining operations of finish-turning, parting off, milling, drilling, etc., are everyday jobs and need no description here. H. A. DUDGEON.

Leicester, Eng.

Milling Spherical Surfaces.

I am sending you herewith a few samples of spherical surfaces, generated by means that, while possibly not at all new to others, are certainly new to us.

In sewing-machine work we use many ball and socket bearings for the connecting rod, which drives the needle lever, and, as far as I know, heretofore the usual means of making these spherical surfaces has been with a formed cutter, which, necessarily, cannot make a spherical surface

MILLED SPHERICAL SURFACES.

unless the diameter of the piece turned is the same as the diameter of the circular face of the cutter, also assuming that the face of the cutter is itself truly circular, which it seldom is.

In addition to this, any change in the position of the cutting edge will affect the shape of the work, and, as a matter of fact, the work is nearly always oval, so much so, that, making a virtue of necessity, we deliberately make the cutter slightly elliptical, with the longer axis at right angles to the axis of rotation of the work, so that when the ball and socket bearings are fitted together, by grinding in with oil and emery, as usual, the high point in the center will wear off and make a pretty good job.

The pieces which I am sending you are generated in another manner, which, as I said in the beginning, is new to me. The work is rotated, and the cutter, which is an ordinary hollow mill, is rotated at right angles to it, with the result that a truly spherical surface is generated of any size, the diameter of which is greater than that of the hole in the hollow mill. It is, therefore, necessary only to have a few hollow mills, as the range of work which they will do is very large.

The samples, Nos. 1, 2 and 3, are roughly made in an ordinary milling machine by turning the index head by hand.

Sample No. 17* is the finished product, made on a machine specially designed for the purpose, and you can see that the cuts are more uniform.

Another advantage of this method of generating ball surfaces is that there will be no grooves in the work, and the ridges left by the cutter will be uniform and will be very readily ground off in the process of "grinding in." ROBERT J. HEARNE.

New York.

[Years ago, when ye editor worked in a machine shop and was one day lapping a plug gage in a speed-lathe, a fire hose hanging on a post nearby had a coupling on which was a ring with two projecting pins diametrically opposite each other for a spanner wrench. The surface of the ring between these pins attracted attention, and being studied, the conclusion was that it had been finished in the way described by Mr. Hearne. In that case accuracy was of course not important, and the only object was to get in between the pins and tool the surface in some way.

Some years ago R. K. LeBlond, of Cincinnati, made a machine for turning pulleys, based upon the same principle, and about the same time John Tangye, then of Birmingham, England, devised and built a large machine for a similar purpose, with which machine he finished the faces of engine belt flywheels.

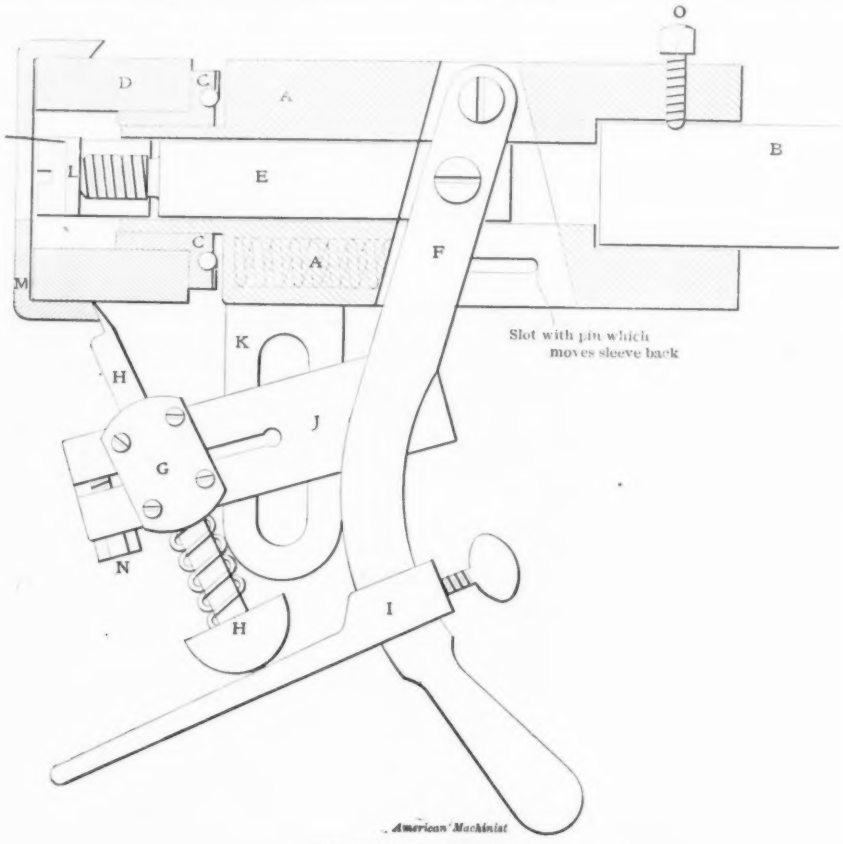
Makers of engineers' transits and other instruments have long employed the principle in finishing the spherical bearings of tangent screws. For this they use a hand tool, which is simply a piece of round steel with a hole drilled into the end of it and the edge turned off to form a circular cutting edge. This and analogous tools were illustrated in these columns September 29, 1888.

Though it is thus shown that the idea of producing spherical surfaces in this manner is old, it is not nearly so well-known as it deserves to be, and we are glad to publish the result of Mr. Hearne's experience with it.—ED.]

*Not shown.

A Tool for Trimming Leather Pump Cups.

The following is a description of a cup-cutting attachment for the lathe to cut center holes and trim edges of leather cups used on hydraulic machines.



LEATHER CUP CUTTER.

This machine is fastened to the spindle *B* of tailstock by means of the set-screw *O*. The leather cup is placed on the wooden block *D*, and the whole machine is moved forward by means of a lever connected with the spindle *B* (this lever is not shown in the drawing), and the cup is thrust into a wooden chuck carried in an ordinary chuck on the live spindle, which is running continuously. Now that the cup is transferred from the block *D* to the revolving chuck, the lever *F* is

pushed forward, moving the cutter bar *E* and knife *L*, which cut the center hole, and cutter *H* trims edge of the cut at the same time.

Although not shown in the sketch, the lever (which we will call lever *R*) which operates the spindle *B* is attached to a rod coming through the spindle of the headstock and pushes out the cup with the backward movement of the lever *R*.

Description of the parts is as follows: *A* is the sleeve; *B*, the tail-spindle; *C* loose sleeve with ball thrust; *D*, wooden block for holding the cup; *E*, spindle with adjustable cutter; *F*, lever; *H*, cutter and spring for withdrawing it; *I*, movable stop to regulate stroke of cutter *H*; *L*, knife for cutting the center hole in the cup; *M*, the leather cup; *R* (not shown), lever for moving tail-spindle.

C. C. Kress.

Limit Gages for Bolts and Nuts.

The articles on the above subject at page 1576, Vol. 27, and at page 192, have prompted me to send you the accompanying blueprint of a set of gages for United States standard bolts and nuts, the limits given being what we have found to be practical in regular agricultural machine work.

A nut to pass inspection must admit of being screwed by hand onto the first step

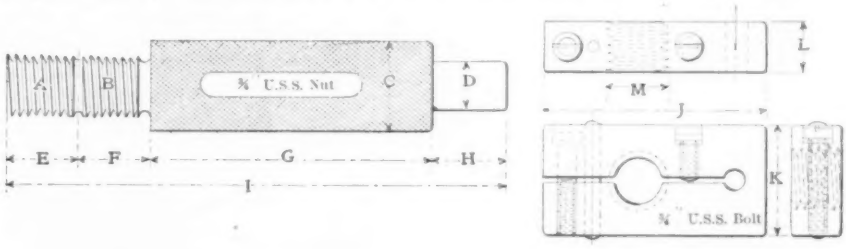


Table for Nut Gage

Size	A	B	C	D	E	F	G	H	I
¼	.250	.253	½	.182	7/16	5/16	5	5/8	1
5/16	.3125	.3155	9/16	.227	5/8	5/8	3 1/16	15/32	1 11/32
3/8	.375	.379	11/16	.291	7/16	7/16	3 1/16	17/32	1 17/32
7/16	.4375	.4415	3/4	.340	1/2	1/2	3 1/16	19/32	1 23/32
1/2	.500	.505	7/8	.396	9/16	9/16	3 1/16	21/32	5/32
9/16	.5625	.5670	15/16	.459	11/16	11/16	3 1/16	23/32	5 11/32
5/8	.625	.631	1	.502	5/8	5/8	3 1/16	25/32	5 25/32
11/16	.6875	.6935	1 1/16	.559	14/16	12/16	3 1/16	27/32	5 31/32
3/4	.75	.757	1 1/8	.615	3/4	3/4	3 1/16	15/16	6 7/16
7/8	.875	.883	1 5/16	.725	15/16	13/16	3 3/4	1 1/16	6 11/16
1	1.000	1.008	1 1/2	.831	1 1/16	1 1/16	3 3/4	1 7/32	7 7/32

Table for Nut Gage

Size	J	K	L	M
¼	2 1/8	1	1/8	1/4
5/16	2 1/8	1	1/8	5/16
3/8	2 1/8	1	1/8	5/8
7/16	2 1/8	1 1/16	5/16	7/16
1/2	2 1/8	1 1/16	5/16	1/2
9/16	2 1/8	1 1/16	5/16	9/16
5/8	2 1/8	1 1/16	11/16	5/8
11/16	2 1/8	1 1/8	11/16	11/16
3/4	2 1/8	1 1/8	11/16	3/4
7/8	2 1/4	1 1/16	13/16	7/8
1	2 1/4	1 1/16	15/16	1

American Machinist

LIMIT GAGES FOR BOLTS AND NUTS.

A of the gage; if it does not go on it is too small, and if it goes over *A* and can be turned onto the limit step *B* it is too large. As the gaging of the nut threads is done at one end of the tool, this permits us to fit the opposite end for gaging the holes in blank nuts.

The bolt gage is adjusted to fit the nut gage at *A*, and the space above the heads of the adjusting screws is filled with sealing wax and sealed while the wax is soft with a stamp made for the purpose. I use a piece of ⅜-inch drill rod, with the letter "T" embossed on the end of it.

W. F. Armour.

An Interesting Drawing-Press Movement.

Your article on "An Interesting Drawing Press Movement," showing a perfect and doubtless most useful principle for driving "blank-holder slides," leaves some doubt regarding the bottom dwell of the bed. I beg to say that it is not a matter of opinion whether there is any bottom dwell or not; it can only be decided upon by graphical or mathematical consideration. Having gone into the matter carefully, I found the diagram absolutely correct.

As to the practical side of the question, I wish to state that of the many diagrams of blank-holder movements I ever laid out, hardly any one showed such a long and comparatively perfect dwell between two drawing operations as this one does, the slight tripping motion in this particular case being of no harm.

To enable other readers of your paper to judge for themselves, I enclose a diagram of a "drawing press" of an entirely different type, whose bottom dwell cannot compare with the one in your Fig. 4, there being no such dwell at all, in fact.

A. C. Sch.

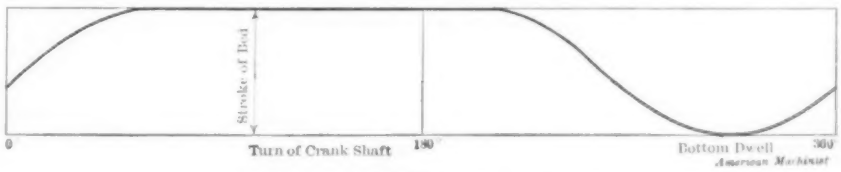


DIAGRAM OF DRAWING-PRESS MOVEMENT.

Passing Our Troubles Along.

"Say, Tom, you fellows work like wooden men. Why couldn't you have left less stock in the bore of those two 3-foot pulleys? You know that is a double-rush job, and when it comes to boring an inch of stock out of a 2½-inch hole 10 inches long, every sixteenth of an inch counts."

"Well, Ed, we couldn't lay our hands on anything that was just right; so we took the cores we could find and used them. Anyway, when a machinist has a job in his chuck it is a small matter for him to just cut a little more stock out of a hole; ever so much quicker than for us to hunt around fifteen or twenty minutes for cores. No; the trouble is with you fellows. You machinists think that everything should be placed right at your feet, so that all you need to do is to turn over your hand and without exerting yourselves, call it done. You fellows are always hunting for something to kick about, and I'll tell you right now it's got to stop; yes, it's got to stop."

The above is a sample of the machine shop foreman's almost daily trouble with the foundry foreman.

"Say, Hammer, those forged rods certainly take the cake, and the blanks for the spur gears are about as bad. Talk about stock! Why, the man on the big lathe says that on the cast-steel kind he can finish up the short end in twenty minutes, but these forged ones take three times as long. A half an inch on the diameter and five-eighths on the ends—that's pretty close forging, I don't think."

"Well, Ed, to come right down to the point, we had no swages the right size, and of course it is cheaper for your man to simply turn off a little more stock than for us to bother about getting them down so close."

This is a sample of the work that is loaded on the machine shop by the boss blacksmith.

"Say, Hughes, why didn't you make your pattern so as to core that oval hole in those thirty valve castings? That will be an endless job of drilling and filing to get them the right shape. Those port holes are oval shape, and they go in on an angle and they will take entirely too much labor for us to cut them out."

"Well, Ed, when I made the pattern I was rushed almost to death. They were

crowding me for every job I had in the shop. As you will notice, the core would have had to be oval shaped and would be a little difficult to anchor, so I just thought I would leave you to drill the holes in those thirty."

Thus you see the tedious work is shouldered off from one department of the shop on to another. I haven't the least doubt that if the machine shop had a department above it, where its product had to be worked and handled instead of being shipped away, two-thirds of its work would be as poorly done.

As it is, do not your planer men grow careless and indifferent occasionally about grinding their finishing tools, turn out a roughly finished job and jokingly remark to one another, "Oh, well, the vise hands must have something to do"?

Nothing is harder on a foreman's temper than such incidents as that of the two three-foot pulleys which I had promised should be done at 5 o'clock. The wagon came on time, but it had to return to town and come out again in the morning.

The life of a man who is shut up in a shop six days out of seven is by no means a pleasant one, and we could make life pleasanter for one another if we tried. There are many ways of doing this, and I wouldn't try to mention them all even if I could; but I think one thing that would help would be for each man to do his level best on his own work, and that would, nine times out of ten, make the next man's work easier.

I know of at least one shop where careless forging didn't go very long. We had a careful foreman. He didn't allow his men to spend too much time on their work, and when a piece came out of the smith shop it was pretty well done. Well, the company thought the forgings were costing too much. They dismissed the man and hired a bulldozing Irishman in his place. It would have taken a mind-reader to have told what some of his pieces were made for. One "lick and a promise" by the steam hammer, and behold! the piece was done. The forgings came out cheap, but how about the machine work? Our output was cut down about a half, and it wasn't long before the old foreman was asked to come back.

In my experience as a machine shop foreman I have had to register dozens of complaints about this careless coring of holes and like work, and always I have been given some woefully lame excuse, as "I didn't have time," or "I couldn't just find what I wanted," etc. All of which can be sifted down to nothing but an avoidance of effort. G. HUGH.

[Drawing the line between the duties of the several departments is of course the duty of a superintendent, and where a good one is in charge such things as described do not occur very often.—Ed.]

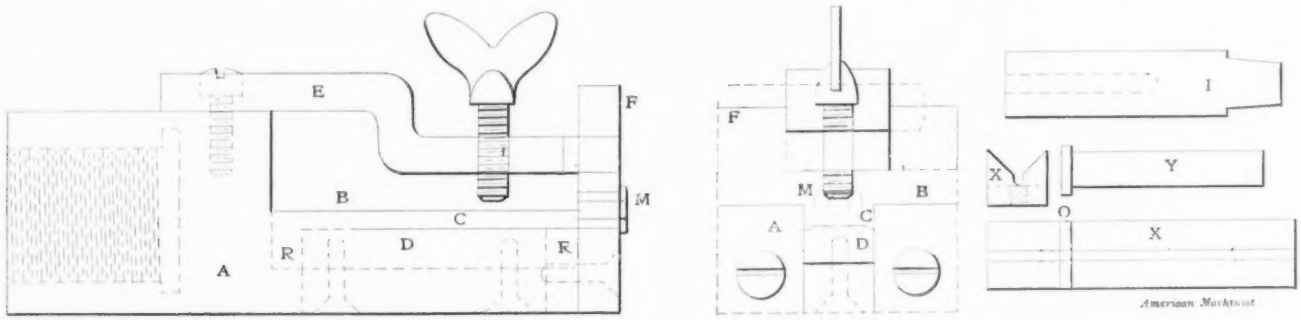
A Drill Jig for the Speed Lathe.

Piece *I* is of cold-rolled ½x¼ inch, which requires a No. 8 drill hole down through the center 1½ inches deep. These pieces are 2¼ inches long. At first glance there is apparently no difficulty about this. So a jig was made to drill them in the sensitive drill press. Reddy was put drilling; after a while Sam (who had charge of the job) went over to see how he was getting along. Reddy was drilling one, and the way he was handling the jig you would imagine there was an electric current connected with it. On inquiry Sam found that the jig and piece proved to be a large nest of trouble. Reddy explained that the first half dozen went all right, "after that it was fierce"; when the drill came near the bottom the hole was so deep the chips did not come out, clogging the drill and causing it to bind, and finally the jig became so hot as to be extremely uncomfortable. As these pieces were made in large quantities, Sam saw that to drill them economically some other form of jig would have to be devised.

One was made which enabled the operator to drill the pieces far more rapidly than could be done in the small drill press. This is shown in Fig. 1. The body *A* is made of soft steel, and is threaded in the back to fit the spindle of the speed lathe. This lathe has a lever attachment connected with the tailstock which enabled the operator to feed very quickly forward and backward. At *B* the jig is planed to one-half. At *C* the jig is recessed to a depth so that when the V-block *X* is placed in position and the pin *Y* is on it, the pin will be central. To drill the piece *I* the block *D* is put in, in order to fill the space and have piece *I* central when placed therein. This part *D* is held in by two flat-head screws. *E* is a swinging clamp used to hold the pieces while being drilled. *F* is a piece screwed on to *A* into which *E* is hooked while clamping down the piece to be drilled. *F* is held on by two flat-head screws and contains the drill bushing for piece *I*. To drill a hole, the clamp *E* is swung out, and the piece is placed in the groove *C*. Clamp *E* is then swung back, engaging in *F*, and by screwing down on the thumb-screw the piece is firmly held for drilling. It can be seen that *E*, being held in *F*, equalizes the strain, which would otherwise be there through such a position.

To form the concave recess in pin *Y*, the piece *D* is removed and the V-block *X* is put in its place, *X* being held by the two flat-head screws. The pin is then placed in so that the head engages in the slot *O* which acts as a stop. The bushing *M* is replaced by one the proper size for the forming tool. In clamping and operating it goes through the same method as in drilling piece *I*.

These pins were bought from another firm and were made by some process which left them very tough. In attempting to form them in the sensitive drill with a jig, it was found to be a great strain not only on the boy's wrist but also on the drill. So by means of the V-block attachment and this jig it became a simple operation.



A DRILL JIG FOR THE SPEED LATHE.

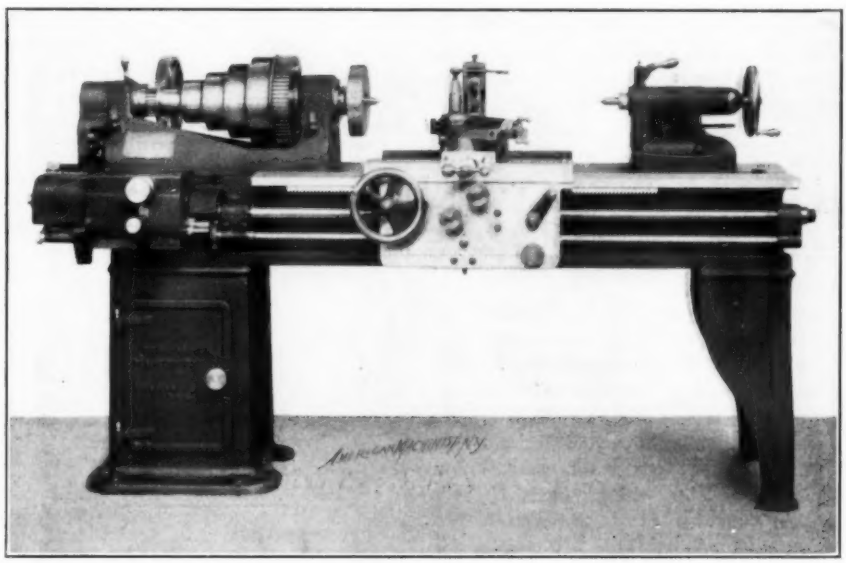
In the front view of the jig, part *F* is shown in dotted lines so as not to make it confusing in any way to understand the other part of the jig. In oiling the drill the boy found it easiest to oil by giving it a daub with a soaked brush, for he could quickly draw it in and out of the work by means of the lever. By having a hinged tin covering over the jig while revolving it eliminates all inconvenience from any oil that might fly. At *R R* there are two holes to allow the chips to drop through. It can be seen that part *D* does extend the entire length of the groove *C*. PEDRO.

The General Electric Company states that 18,500 men are now employed at its Schenectady plant, the largest number in its history.

16-Inch Engine Lathe.

The Fosdick Machine Tool Company, of Cincinnati, O., well known to our readers as builders of radial drills, have just brought out a 16-inch lathe which is shown in the accompanying half-tone. This lathe is equipped as illustrated, with feed box and with compound rest. The bed is made in different lengths from 6 to 12 feet, with cabinet or regular legs, and with or without oil pan. The spindle bearings are 2¾ and 2⅛ inches diameter; there is a 1¼-inch hole thru the spindle, and draw-in chucks are furnished when required. The bearings are bronze bushed throughout, and constant lubrication is afforded thru an endless chain and large oil pockets. Owing to the design of the head a three-step driving pulley may be used in place of the five-step cone, insuring a more powerful spindle drive when required for high-speed steel work.

The carriage has bearing surfaces of ample length and width on the shears,



16-INCH ENGINE LATHE.

and the apron is of the box-section type, insuring strength and stiffness. The design of the tailstock is clearly shown, and also that of the follow-rest. The compound rest is designed to receive a heavy tool-post. The compound feed box shown is the well-known Emmes device, giving forty changes, the screw-cutting feeds ranging from 2 to 56 threads per inch, and the feeds for turning being just one-fourth as coarse.

The taper attachment can be placed on any of the lathes without changing the bed or fitting it with brackets, and a turret of pentagon form, for the carriage, can be furnished when desired.

All screws on any part of the lathe requiring adjustment are operated with the tool-post wrench. The friction countershaft has self-oiling bearings and oil wells are formed in the friction pulleys.

The swing over bed is 16¼ inches, and over carriage 10¼ inches. With the 6-foot bed, the length taken between centers is 34 inches. The width of the five-step cone pulley face is 2⅝ inches, and of the three-step 3⅜ inches. The countershaft speed with five-step cone is 120 revolutions per minute, and with three-step cone 250 revolutions per minute. The weight of the lathe with 6-foot bed is 2,000 pounds.

Program for the Scranton Meeting of the A. S. M. E.

Secretary Hutton has sent out the official program for the spring meeting of 1905, of the American Society of Mechanical Engineers, to be held at Scranton, Pa., June 6 to 9. The headquarters of the society will be at Hotel Jermyn, and the professional sessions will be held in the auditorium of the Y. M. C. A. building.

On Tuesday evening, June 6, there will be an address of welcome by William F. Matt's, chairman of the local committee, with a response for the society by the president, John R. Freeman. The discussion of professional papers will then be taken up as follows:

"The Transfer of Heat at High Temperatures," by Frank C. Wagner.

"Standard Units of Refrigeration," by F. E. Matthews.

"Formation of Anchor Ice and Precise Temperature Measurements," by Howard T. Barnes.

"Some Types of Centrifugal Pumps," by Wm. O. Webber.

On Wednesday morning will occur the only business session of the meeting, when will be received the reports of tellers of election and of committees, and general business and any new business will be attended to. The professional papers will be as follows:

"Microstructure and Frictional Characteristics in Bearing Metals," by Melvin Price.

"Cast Iron, Crushing Loads and Microstructure," by Wm. J. Keep.

"Smoke and its Abatement," by Chas. A. Benjamin.

The session of Wednesday evening will be entirely devoted to professional papers, as follows:

"Can a Steam Turbine be Started in an Emergency Quicker than a Reciprocating Engine of the Same Power?" by A. S. Mann.

"Note on Efficiency of Steam Generating Apparatus," by A. Bement.

"Performance of a Superheater," by A. Bement.

"Counterweights for Large Engines," by D. S. Jacobus.

"Steam Actuated Valve Gear," by Wm. H. Collier.

The concluding professional session will be on Thursday morning, when the following papers will be presented:

"Notes on Heads of Machine Screws," by H. G. Reist.

"Belt Creep," by W. W. Bird.

"Function of Laboratory Courses in the Curriculum of Engineering Schools," by Chas. E. Lucke.

"Continuous Measuring and Mixing Machines," by E. N. Trump.

"Epochs in Marine Engineering," by Geo. W. Melville.

On Wednesday afternoon a reception and tea will be tendered the visiting ladies by Mrs. Benjamin Dimmick. A reception by the local members of the society, together with the Scranton Engineers' Club, the Board of Trade and the citizens of Scranton, will be tendered the officers, members and ladies of the society at the Scranton Bicycle Club on Thursday evening. Excursions and visits to various works are planned for all the time not otherwise occupied, some of which are yet to be announced in detail. The members are as usual earnestly requested to turn in their railroad certificates as soon as possible.

The New York Meeting of the American Foundrymen's Association.

The annual convention of the American Foundrymen's Association is to be held this year in New York city, June 7-9. The headquarters will be at the Murray Hill Hotel. An unusually large attendance and many valuable papers are promised. One full day is to be spent at Columbia University by special invitation. The conventions of this association attract many ladies and they are always well cared for. The usual arrangement is made for reduced railroad fares. The address of Dr. R. Moldenke, the secretary, is Watchung, N. J.

The effective temperature of the radiating surface of the sun is calculated to be about 6,000 degrees Cent. (10,800 Fahr.) while a minimum for the sun's center is possibly 9,000,000 degrees Fahr.

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The Atbara Bridge and the Panama Steamers.

It will be remembered that some time ago a great many Americans were highly commending the action of the British Government in coming to America to contract for a certain bridge, known to fame as the Atbara Bridge. This was a bridge to be erected in a far-distant land by the British Government, and it was ordered from the Pencoyd Iron Works because it could be had in much shorter time, and for considerably less money than a similar bridge could be obtained for in Great Britain.

It now appears that the Panama Canal Commission proposes to do exactly the same thing with regard to steamships which it needs, to ply between America and Panama. It is found that two such steamships as are required can be purchased abroad for $700,000, and that there will be immediate delivery; whereas, if American vessels are to be obtained, delivery will be delayed a year or more, and the cost will be $1,400,000, or just double what the foreign vessels will cost. Now, the curious feature of the situation is that many of those who so highly commended the action of the British Government in buying the Atbara Bridge here, are just as strenuously, or even more strenuously, objecting to the action of our Panama Canal Commission in doing precisely the same thing, under precisely the same circumstances.

One of the most amusing features of the case is, however, the pronouncement of the editor of the *Manufacturers' Record* of Baltimore, who declares that this action of the Panama Commission is a serious blow to American industries, and that it will result in "letting foreigners know that they can buy things more cheaply at home than they can in America." We really wonder what kind of people the editor of our contemporary thinks foreign buyers of American goods are, and whether he really thinks that they are buying them in ignorance of the prices at which similar goods can be bought at home, and that they will continue to buy them in ignorance of this important fact until they are advised by the action of our government that they are buying contrary to their own interests?

It is a too common fault of Americans that they underestimate the shrewdness and intelligence of foreigners, but we do not remember to have before noticed a case in which this sort of blindness went quite so far.

At page 608, in dealing with the subject of our foreign machinery trade and in speaking of the New York *Tribune* in connection with that trade, we said that this paper has been "in the habit of maintaining that the present tariff is perfect, and inviolable." This statement is what editors are in the habit of calling a slip of the pen, and does the *Tribune* injustice. Its attitude toward the tariff has been more liberal and broad-minded than is indicated by the language referred to, and this is clearly shown by its comment upon the action of the Panama Canal Commission regarding the purchase of steamships and material abroad, or rather in the cheapest market. Regarding this, the *Tribune* says in its issue of the 18th, "when the stand-patters drive home to the people a realization of the fact that steel rails can be purchased abroad for the Panama railroad at $20.00 a ton, whereas they would compel the government to pay our manufacturers $33.00, though our manufacturers would deliver those same rails in Great Britain for $22.00 a ton which cost them at Pittsburg about $12.00 a ton, instead of winning sympathy for our traders so abused by their own government, they will awaken sympathy for our private consumers." Further referring to this the *Tribune* says, "they [the stand-patters] are using the American control of the canal zone as a mere pretext for raising prices far above what they have been accustomed to ask there, though new opportunities for trade at the old rates should more than satisfy them. While Panama was a part of Colombia, we sent there large quantities of building hardware, steel rails, tools, machinery and locomotives in competition with Europe. Panama was then foreign territory, and our traders were perfectly willing to compete with foreigners. It is still foreign territory; it is not a part of the United States. We lease some land there, but it is not within our tariff wall; it is not one mile further away; there is no reason why our traders should expect more for laying down a rail or shovel in Panama for their own government than for the French or Colombians."

They are proposing to erect a large power plant in the center of the Indiana coal fields for the generation of electricity to furnish power for the traction lines of central and southern Indiana and for general light and power service. It would seem to be just as sensible and proper to establish large power plants at the coal mines as at waterfalls, and the wonder is that more such enterprises are not under way. Long-distance transmissions are quite as possible in Indiana or Illinois or Pennsylvania as on the Pacific Coast, and the cost of steam installation is not so great, as compared with that of a water-power plant, as to be at all prohibitive.

The architects' plans for the new house for the engineering societies, the gift of Andrew Carnegie, were filed with the building department May 13. The building is to be fifteen stories high and the official estimate of cost is about $1,250,000. At one time, long ago, it seemed as though we might some day be able to publish some account of this building, with illustrations. But the hope has vanished.

Tenth Annual Convention of National Association of Manufacturers.

EDITORIAL CORRESPONDENCE.

The convention was called to order the morning of May 16, in the auditorium of the Grand Opera House, Atlanta, Ga., by R. S. Maddox, president of the Atlanta Chamber of Commerce. Following the opening prayer, the delegates were welcomed to Atlanta by Governor Terrell, by Mayor Woodward and by the Hon. John T. Graves. The address of Mr. Graves was noteworthy. He is an accomplished orator, spoke with excellent feeling and good taste and was listened to with profound attention. I have seldom heard anything finer than his word picture of the soldiers of the Confederacy returning from defeat and disaster at the front to ruin and desolation at home.

The addresses of welcome were responded to by Mr. McCarroll.

GOVERNMENT REGULATION OF PUBLIC CORPORATIONS

The business proceedings of the convention were opened by the reading of an address by Mr. Ludwig Nissen on "Governmental Relation to the Public Franchises." Mr. Nissen's address was of a very thoughtful character and treated chiefly of the causes that have brought about the present discussion of the control of freight rates by the Federal government. He considered the present tendency to be to eliminate the law of supply and demand from the setting of freight rates and considered governmental regulation as bound to come if this condition continues. Our governmental system contemplates a minimum of interference with individual activity, the result of which has been the present condition in which the trend of public opinion in the effort to check the evils of control by monopoly is toward the other extreme—municipal or state socialism—although nothing is more foreign to the spirit in which the establishment of our government was conceived. He considered that only the good sense of those in control of the railroads of the country could prevent governmental interference, the feeling in favor of which is the outgrowth of the trust movement.

He proceeded to discriminate sharply between two classes of these combinations. The first class comprises the combinations of prior existing corporations in the field of manufacture, while the second comprises the combination of public utility corporations, a distinguishing feature of which is that they make use of public highways or that they have obtained their rights of way through the exercise of eminent domain. The effects of the first class of combinations has been in the main beneficial. They are largely responsible for our recent great industrial development, their operations are international in their character and they do not exist by the favor of the state or the nation. The second class of public-service combinations provide a service which is chiefly local and they have done great harm. Patronage of the first class is voluntary, while that of the second is compulsory. Unlike the first, the second class are creatures of the state.

The action of these corporations is responsible for the demand for state ownership, and if continued upon the present lines must lead to municipal, State or national ownership, the effect of which would be to stop the progress of the world. While he was a sincere hater of socialism, he felt that the law must control monopoly as it does the individual. Public service corporations should be under public surveillance. They should not be allowed to issue capital in excess of investment. Whenever a charter is granted of this character, it should be upon the condition that the service is adequate to the public need, and it should be forfeited unless this is the case. These corporations should not be allowed to sell or lease their properties except under terms that will respect public interest. All which do an interstate business should be under the control of the Federal government. He considered the personality of President Roosevelt eminently fitted to cope with the situation.

COTTON.

The next address was by P. A. Tompkins on "The Present and Future of Cotton from the Plantation to the Loom." The chief object of Mr. Tompkins' paper was the presentation of a scheme for storing and grading cotton and then selling it upon certificates, somewhat after the plan of the great grain elevators of the Northwest, and very similar to the pig-iron warrant system which prevails in Scotland. He described the extremely critical conditions under which cotton is raised. A certain amount of frost is necessary to kill insect pests, so that it cannot be raised successfully below the frost line, and on the other hand, early frosts kill a large portion of the crop, and thus lead to a shortage, although the preceding conditions may have been very favorable. Because of these conditions, the price is very mercurial, a condition which is disastrous to the interests of the grower and manufacturer alike. He favored the organization of a cotton storage and guarantee company, which should employ an expert corps of graders to classify the cotton in all those respects by which it varies. The warehouses already exist, but the system is not feasible at present, because the responsibility of the warehouse owners is not sufficient for the purpose, or if sufficient is not known. These warehouses should be rented by the proposed corporation and suitably bonded.

Under this system the certificates would be bought by the mills at times when the prices are low, the cotton remaining in the warehouse until wanted. Under present conditions the farmer with few financial resources must carry the cotton; whereas, under the new conditions, this should be done by the mills, which have ample resources of this kind. In this way the large yield of one year would be offset against the short yield of another year, and prices would be much more stable.

He did not look with disfavor upon the efforts of European governments in encouraging the raising of cotton in India and Africa, as through it a short crop in one section would be at least partially neutralized by a large crop in another section.

TUESDAY AFTERNOON SESSION.

The session was opened with the announcement that as the report of President Parry is in type, it would not be read. The report is too voluminous for adequate presentation in abstract. It deals with the growth of socialistic ideas; the labor situation, which he regards as more satisfactory than of late; not less than fifteen hundred concerns, he says, have changed from the closed to the open shop during the year. Railway-rate legislation and the tariff and reciprocity are discussed at considerable length, the effect of our high tariff in bringing about retaliatory measures abroad being pointed out.

The president next announced the various committees, after which the convention listened to an address by Judge Daniel Davenport, on the "Necessity of Organization, National and Local, by Manufacturers and the People." Judge Davenport's address was largely upon the subject of labor unions and the methods of counteracting their influence in order to preserve individual rights and liberty, which, together with the rights of property, are being attacked. He also discussed at considerable length the question of railway rate regulation, and pointed out that a very large portion of the people are interested in the maintenance of railway earnings, because railway securities form such a large proportion of the investments of life and fire insurance companies and savings banks. He was violently opposed to the regulation of these rates by the Government, which he regarded as equivalent to taking from the owners of the property the most essential feature of its management, while still leaving them to carry the risks of the business. He pointed out that by the Constitution the power of Congress extends over all phases of interstate commerce, and contended that Congress is just as much empowered to determine the price of merchandise as to determine the rates at which it shall be transported.

The next business was the reading of the report of the committee, upon

INTERSTATE COMMERCE.

The committee had given extended study to the subject, and it did not seem to them difficult to agree upon some legis-

lation which would be generally satisfactory. Unless this is done, the committee felt sure that much more drastic laws will be the ultimate result. The committee considers that some improvement has been effected already. The payment of rebates in money has been practically stopped, but substitutes have been invented. Practically speaking, there is no competition among the railroads, and they can fix rates at pleasure. Recourse to the law in cases of discrimination is of little avail, because the result does not apply to shipments other than those subject to litigation. The committee considered a tribunal especially constituted for the correction of these abuses a necessity. Many people are alarmed because they consider the object of such a tribunal to be the fixing of rates, an impression which is erroneous. The scope of the tribunal is intended only to cover cases in which the rates are unjust, discriminating or unreasonable. This tribunal should be empowered to hear and decide cases of alleged discrimination. The report concluded with resolutions approving legislation upon these lines. It also provided for the regular examination of the books of railroad companies, somewhat after the manner of the present examination of the books of banks.

These resolutions were opposed by Mr. McCarroll, who pointed out that while the body of the report disclaimed any intention to empower the tribunal with authority to fix rates, the resolutions offered did that very thing—a provision which strikes at the very foundation of our government. He considered that it would be very unwise for the association to endorse these resolutions, especially in view of the fact that a committee of the Senate is now engaged in an extended investigation of the subject.

Nevertheless the situation must be faced. We must acknowledge that there are abuses in many of the features of the administration of railroads, and we must recognize the existence of injustice and inequality. He considered the laws now upon the statute books as at least measurably equal to the situation, but they are ineffective because they are not enforced. He considered that the power of enforcing these laws should be conferred upon the Interstate Commerce Commission. He moved that the resolutions as offered by the Interstate Commerce Committee be referred to the Committee on Resolutions, and that they be instructed to prepare a new set on these lines.

The next business was the reading of the report of the committee on

TARIFF AND RECIPROCITY.

The committee considered that the action of the Senate regarding the proposed reciprocity treaty with Newfoundland gives little hope of any action by Congress at present. The committee had prepared a series of resolutions upon the subject, which were turned over to the Committee on Resolutions.

The report of the Committee on Irrigation was ordered printed, but not read, and the same was done with an address by Edward Atkinson on "Fire Protection."

The next report to be read was that of the Committee on

INDUSTRIAL EDUCATION.

The committee stated in its report that it had given the subject extended investigation, having inquired into the organization and workings of the German and French industrial schools with a good deal of minuteness. The report was in the main an exposition of the manner in which the apprenticeship system had broken down, and considered the organization of schools to take its place of the first order of importance. The committee stated that 98 per cent. of the present generation of boys has no training looking directly toward the earning of a livelihood. The least satisfactory feature of the report was its lack of suggestions as to means by which the desired schools are to be established. The committee had nothing to suggest beyond the munificence of individuals and corporations.

WEDNESDAY MORNING SESSION.

This session opened with a report of progress by the Committee on Commercial Education. The committee announced that it had given the subject much attention, and that it had especially considered the means by which its aims were to be carried out. The work was, however, still in an incomplete state, and the committee desired to be continued, promising to submit a complete report at an early date—perhaps at the next meeting of the executive committee.

MR. FOSS ON TARIFFS AND RECIPROCITY.

The new thing upon the program was the reading of an address by E. N. Foss on "Tariff and Reciprocity." Mr. Foss announced himself a thorough believer in the principle of protection, but a free-trader would scarcely have scored the existing tariff more strongly than he.

He related the experiences that followed the four experiments in reciprocity which the country has made, the chief of which of course was the reciprocity treaty with Canada, which was in force during the years between 1855 and 1866. The effects of this treaty were altogether favorable to both countries, while the effect of its cancellation was naturally hostile tariff action by Canada. Other treaties of this kind, which formerly existed between this country and Hawaii, and with some of the West India islands have given equally favorable results, and the existing treaty with Cuba has had a similar effect.

He stated the effect of our existing prohibitive tariff to have been to array all of the nations of the world against us, and proceeded to give a concise statement of the retaliatory measures which have already been passed by foreign governments.

He referred also to the killing of the series of reciprocity treaties in the Senate last winter by the protected interests, explaining that the concessions made were, in many cases, extremely small, and left ample protection in lines of manufacture in which heavy export business is now done. The treaties, as a whole, were killed by simple log-rolling methods, the senators mutually favoring one another regarding bills which were objectionable to their constituents, the action of the beet-sugar trust in forcing an amendment to the treaty with Cuba being especially reprehensible. He considered limited protection to be the only defensible protective policy, and considered that the outgrowth of the existing schedule is graft and corruption.

He regarded reciprocity as a common meeting ground for the protectionist and the free-trader. Unless the abuses of the protective system can be remedied, he considered that the country would fail to meet its best opportunities, and he asked, "have not the manufacturers overplayed the game of protection?"

He regarded the situation which had been provoked abroad to be little short of appalling. The recent tariff law of Germany, for example, places within the power of the German government the ability to practically destroy our trade with Germany. He outlined what has been done, as well as what is in prospect, in France, Austria, Switzerland, Russia and Canada, all of which he attributed to the prohibitive tariff act of 1897.

Our action in the matter of sugar had served to increase the duties against us in Russia by from fifty to one hundred per cent., and as a net result of what he regarded as our outrageously high duties, our entire foreign trade is hanging in the balance.

The difficulty is that while practically all manufacturers are in favor of reciprocity, none are willing to see concessions made in duties on their own goods.

SOME RESOLUTIONS.

Following this, some resolutions were brought in by the Committee on Resolutions and passed with enthusiasm. They re-endorsed the principle of the open shop, denounced the "crimes and outrages on personal liberty" which have taken place during the teamsters' strike in Chicago, called upon the Department of Commerce and Labor to investigate the subject of preferential duties in other countries, and upon Congress to act promptly in order to protect our markets from the rising tide of discrimination. A resolution was also passed calling for the passage of a bill for the upbuilding of the American merchant marine, which resolution did not, however, include the word subsidy or any equivalent of it.

By another resolution, adopted by a rising vote, the members of the association pledged themselves to place no obstacles in the way of apprentices serving in their

shops from learning all branches of the trades of their choice.

REGULATION OF RAILWAY RATES.

Following this, the convention listened to an address by Samuel Spencer, president of the Southern Railway. Mr. Spencer's address related to the proposed regulation of railway rates by a government commission. He began by saying that the business of the common carrier is one which is properly subject to regulation by legislation. He pointed out, however, that so far the anti-trust law has been a failure, the result being that instead of their suppression, which was the object of this law, the trusts have continued to grow until they practically represent the progressive industry of the country.

He was, of course, opposed to the proposed regulation of railway rates, pointing out that while its avowed object was only the correction of abuses, the granting of this power to a commission was bound to carry with it the general power to fix rates. He considered that the Interstate Commerce act had enormously diminished the abuses of rebates and unjust discrimination, and that existing laws, if enforced, were ample for their suppression.

He considered that the remedy for existing evils "lies in throwing the searchlight of public knowledge and public scrutiny upon all corporate action . . . in a system of governmental supervision and inspection, which can successfully prevent or punish all infractions of the law."

PANAMA CANAL PURCHASES.

Following this, the Committee on Resolutions brought in a resolution condemning the Isthmian Canal Commission for its decision to purchase materials for the canal abroad. These resolutions led to a sharp debate, and on being put to a vote were lost. In the opinion of some, the resolutions were too broad in that they covered all of the materials of construction, some of which obviously could not be supplied from this country, and, no doubt, some votes were lost to the resolution which would not have been had it been of narrower scope.

WEDNESDAY AFTERNOON SESSION.

CO-OPERATIVE INSURANCE.

The afternoon session was opened by the reading of the report of the Fire Insurance Committee. The report, which had already been submitted to the Executive Committee, advised that a fire insurance bureau be organized for the conduct of the insurance business of the members, and for the purpose of advising them regarding all matters connected with fire insurance—an appropriation of $10,000 being recommended for the maintenance of the bureau.

The proposition was warmly opposed by Mr. Skinner, who stated that it would antagonize the agents of the fire insurance companies throughout the country and that this the association could not afford to do. He believed that a bureau of information might be maintained with advantage, but that the association could not wisely undertake the business of insurance brokerage. In reply it was pointed out that the matter had had extended investigation and that large numbers of the members were in its favor.

Following this came a report of the Strike Insurance Committee, which had found only a limited demand for such insurance among the members. The result of its investigation was to lead to the conclusion that strike insurance could probably be supplied on the mutual plan at a net cost of about 3-10 of 1 per cent. per annum. While the existing demand for such insurance is limited, it seemed to be sufficient for a start should that be decided upon. The committee, however, was not prepared to recommend the organization of a strike insurance bureau, but asked to be continued for another year.

Following this came an eloquent address by James Emory, of California, which was devoted chiefly to the discussion of the labor problem. He regarded it as monstrous that such a subject as strike insurance should be suggested, when the only question at issue was, in his opinion, the preservation of law and order, and the suppression of violence. He warmly urged the formation of defense and citizens' associations and claimed that through such associations the power of the unions on the Pacific Coast had been practically broken.

RAILWAY REGULATION.

Following Mr. Emory's address, which was warmly applauded, the Committee on Resolutions brought in a series of resolutions calling for the enforcement of the laws for the prevention of rebates by the railroads, and for the passage of additional laws if necessary. The resolutions also demanded the institution of a system of examination of the books of railroad companies by the Government on the lines of the examinations of banks as now conducted. These resolutions were carried and represent the result of a good deal of discussion before the association. The regulation of rates by the Government was ably advocated in the report of the Inter-State Commerce Committee, and as warmly approved by many and, at the opening of the convention, apparently by a majority of the members. The passage of the more conservative resolutions by an association whose members may be supposed to have more grievances against the railroads than any other class in the community was, perhaps, the most significant action of the entire convention.

Resolutions were also offered by the committee and passed by the convention, pledging the support of the association to the employing printers of the country in the case of a strike, of which rumors are now heard.

PATENTS AND TRADE-MARKS.

Following this came a report of the Committee on Patents and Patent Law. This report told of the successful efforts of the association at the last session of Congress in obtaining the passage of a satisfactory trade-mark law. It also related the failure of the attempt to secure the establishment of the National Court of Patent Appeals, although it expressed the belief that such a court could be secured if the demand for it were made sufficiently prominent. The report also dwelt upon the necessity for an extension of the facilities of the Patent Office. Resolutions from the Committee on Resolutions were then presented and passed, calling for a Court of Patent Appeals and for an extension of the facilities of the office.

THURSDAY MORNING SESSION.

MORE TARIFF DISCUSSION.

This session was opened by a paper by Mr. Seabury, the title of which was "Tariff Revision and the Remedy."

Mr. Seabury's address was a protectionist argument of the extreme type. He pointed out that every suggestion for the revision of tariff laws led to the stagnation of trade. He insisted that the tariff be taken out of politics and be put into the hands of an expert tariff commission, which would be more capable of dealing with the subject than Congress and would be free from the political and other malign influences to which Congress is subject. He did not believe in extreme protection, but he wanted all foreign goods kept out of this country. He referred to the practice of selling American-made goods in foreign markets at a lower price than at home, and defended the practice, claiming that such sales represent the manufacturer's surplus product, which could not be sold at home, and that their effect was to provide employment for labor to the injury of no home industry. He denounced all who urged lower duties or reciprocity. He referred at length to the demand of Governor Douglas of Massachusetts for free hides, in order to promote the export trade in shoes and demonstrated to his own satisfaction that the largest manufacturer of shoes in the world is an ignoramus regarding the conditions of his own business.

There was no discussion of this paper except a warm denial by Mr. Metcalf, who spoke as a representative of the largest manufacturer of agricultural implements in the world, and who denied that American-made agricultural implements are sold at lower prices in foreign than in home markets. He also pointed out that American-made shoes are sold in London, but not in Paris or Berlin, and attributed the fact that there are none sold in the last named cities to the absence of reciprocity treaties.

INCORPORATION OF THE ASSOCIATION.

Following this came a report of the Committee on Incorporation. Although considered highly desirable, it had been

found impossible to obtain a charter from the Federal government. The various State laws had been carefully examined and as those of New York had been found to be very hospitable toward associations of this kind not formed for profit, and as the offices of the association are in New York city, the preliminary steps for incorporation in that State had been taken and the convention was asked to authorize the officers of the association to affix their signatures to the papers and thus complete the act of incorporation. This authorization was given.

FINAL RESOLUTIONS.

The Committee on Resolutions then offered an extended series of resolutions, which commended the investigation of the effect of the proposed eight-hour law by the Department of Commerce and Labor; opposed all kinds of compulsory legislation affecting only classes of citizens; opposed all attempts at anti-injunction legislation; endorsed the action of the Citizens' Association of Chicago; called for investigation by the Committee on Patents of the patent laws of various countries; endorsed the proposed celebration in 1907, of the centennial of the inauguration of steam navigation on the Hudson river; called for laws to put an end to the abuses connected with the taking up of public lands, endorsing the legislation regarding the irrigation of the arid section of the West; constituted the officers of the association a permanent committee to advocate trade schools; and ended with the usual vote of thanks for the hospitality which had been received at the place of meeting.

New York city was then selected as the place of the next annual convention.

The election of officers for the ensuing year was the next and concluding business. The Nominating Committee reported the name of D. M. Parry for president, and D. A. Tompkins and William McCarroll were nominated from the floor. Mr. McCarroll promptly declined. Considerable discussion then ensued regarding the policy of the association in the matter of rotation in office, of which several members were strongly in favor While all appreciated and endorsed the great services of Mr. Parry, under whose administration the membership has increased over three-fold, there was, nevertheless, a feeling that an injection of new blood was highly desirable. In the course of this discussion it was urged that failure to reelect Mr. Parry at this time might be construed as a condemnation of his policy on the labor question, and this appealed so strongly to Mr. Tompkins that in an admirable speech he withdrew his name. The unique compliment was then paid Mr. Tompkins of passing a resolution by which he was authorized and instructed to cast one ballot for Mr. Parry, and this was done.

Following the election of Mr. Stillman as treasurer, and of the various vice-presidents from the different States, the convention then adjourned.

MR. METCALF ON OUR FOREIGN TRADE.

Following the formal adjournment, the delegates assembled in the evening of the same day to listen to an address by Hon. Victor H. Metcalf, Secretary of the Department of Commerce and Labor, on the "Extension of Foreign Trade." If any of Secretary Metcalf's hearers had been disposed to look upon existing achievements of American manufacturers in extending foreign trade as something to be very proud of, their self-complacency must have received a severe shock at his hands. His address was largely statistical and it pointed out in an almost pitiless manner how small a percentage of manufactured goods consumed by non-manufacturing nations is supplied by American manufacturers. In discussing the necessary means for bringing about an increase in our foreign trade, the subject of subsidized shipping was, of course, referred to, but not at any length, and, contrary to the expectation of many, it formed a very small portion of the address. The speaker gave his audience to understand that the burden of increasing export trade lay chiefly with the manufacturers themselves. He also pointed out the potential usefulness of the Department of Commerce and Labor, but pointed out that for the realization of this the co-operation of the manufacturers was essential. He considered the most promising field for the extension of this trade to lie in Central and South America, Asia, Australia, and Oceanica. The hostile tariffs of European governments were not referred to.

He considered that the completion of the Isthmian Canal would make it possible for us to dominate the markets of the Pacific, but insisted that manufacturers should not supinely wait for the completion of the canal. On the contrary, he considered that the time has already arrived for the invasion of foreign markets by American manufacturers.

EXTORTIONATE HOTEL CHARGES.

A report of the proceedings of this convention would not be complete without referring to the despicable action of the leading hotel of Atlanta* in raising its rates. Rumors prevailed during the convention that this action was the result of a concerted movement by all of the hotels of the city, but that with one exception they all lost their nerve. This one certainly did not, as my own experience will testify. The usual rates of this hotel on the American plan, as given out by the association, range from $3.00 to $5.00. On registering Tuesday morning, I was assigned to a room, and on going to it found it to be of the most modest character and fitted with two beds for as many occupants. At breakfast I glanced at my meal ticket and was electrified to find my rate entered thereon as $7.00 per day. Going to the desk immediately after breakfast, I asked if my understanding was correct, and on being informed that it was, called for my bill for the breakfast. This breakfast, I should add, had been very unsatisfactory, as most of it was guiltless of any recent acquaintance with the fire, but the bill for it was $1.75, to which was added a charge of 50 cents for getting my baggage—a suit case—from the depot to the hotel.

Comment, I think, is unnecessary further than to say that indignation at this policy was heard from the people of Atlanta far more than from the delegates to the convention. F. A. H.

*The Piedmont.

A Modern Electric Hydraulic Elevator Plant.

In various business establishments where considerable power is employed—and where is it not?—and where the power is required to be variously transmitted and applied, electricity is rapidly asserting its supremacy as the agent of transmission. Perhaps no more striking illustration of electricity's assertive way is to be found than in the modern department stores of enterprising cities, and the John Taylor store of Kansas City, Mo., is typical of the most advanced practice.

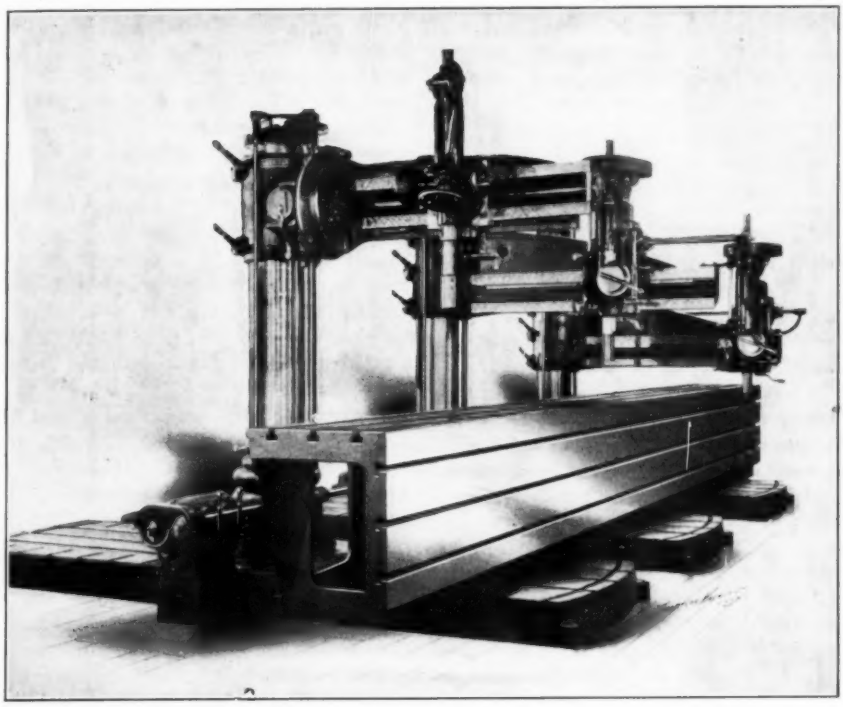
The power plant of this establishment comprises three direct-connected generator units, two of 75 kilowatts each and one of 160 kilowatts. Power is distributed electrically for feed pumps, elevator pumps, ventilating fans, ice machine, circulating pump, etc. Every moving apparatus is driven by an electric motor.

A notable and interesting feature of the plant is the battery of three high-pressure turbine pumps for the elevator service. These are Worthington three-stage motor-driven turbine pumps. Two of them are 300 gallons per minute capacity each, and the third of 500 gallons, all maintaining a pressure of 140 pounds to the inch. These are operated singly or in combination according to the fluctuating demands of the service. The motors are under the control of standard Cutler-Hammer automatic controlling apparatus. The operation of the turbine pump is such that a controlling device is not required except from considerations of economy. The pumps will automatically cease to discharge when the maximum pressure is reached, and the current consumption of their motors will fall to that required merely to rotate the masses of water in the impeller chambers. When the pressure is reduced discharge begins, and the current increases proportionately to the amount of pumping done. The controlling mechanism is merely introduced as conducive to economy. The plant was designed and its construction was superintended by the engineering office of W. K. Palmer, Kansas City.

New Tools and Machine Shop Appliances.

COMBINATION LOCOMOTIVE FRAME DRILLING MACHINE.

The accompanying illustration presents a new combination radial and locomotive frame drilling machine recently installed in the new shop of the Louisville & Nashville Railroad Company at Louisville, Kentucky. It is designed to use high-speed steel twist drills and taps.



COMBINATION LOCOMOTIVE FRAME-DRILLING MACHINE.

As will be seen, the machine consists of three 6-inch radial drills, two plain and one full universal, each with double bases and one long T-slotted table extending across them. The three drills are driven with one direct-current motor thru a four-speed box on the base of each, which may be operated by the two levers shown, while the machine is running. The connection between the speed boxes and the drills is thru spur gearing. The connection between the three drills is by couplings, the shaft which connects to the motor passing thru the lower part of the stump wherein it is journaled. The stumps extend to the top of the columns, affording a support for them.

Each drill is a complete unit in itself, and may either be used to work on a locomotive frame clamped to the long table or the arm may be swung around to do regular work on the opposite end of the base. Each arm may be swung in a complete circle without touching an adjacent column.

The back gears, being on the heads, not only deliver the power direct to the spindles, but, thru levers, enable the operator to have full control at all times. This permits tapping with back gears in when required, and changing the speed for backing out without stopping the machine.

The spindle is started, stopped and reversed by a lever on the head, which obviates the necessity of stopping any of the running parts except the spindle.

The tapping attachment, controlled by the same lever, is carried on the back of the head between the back gears and the speed box.

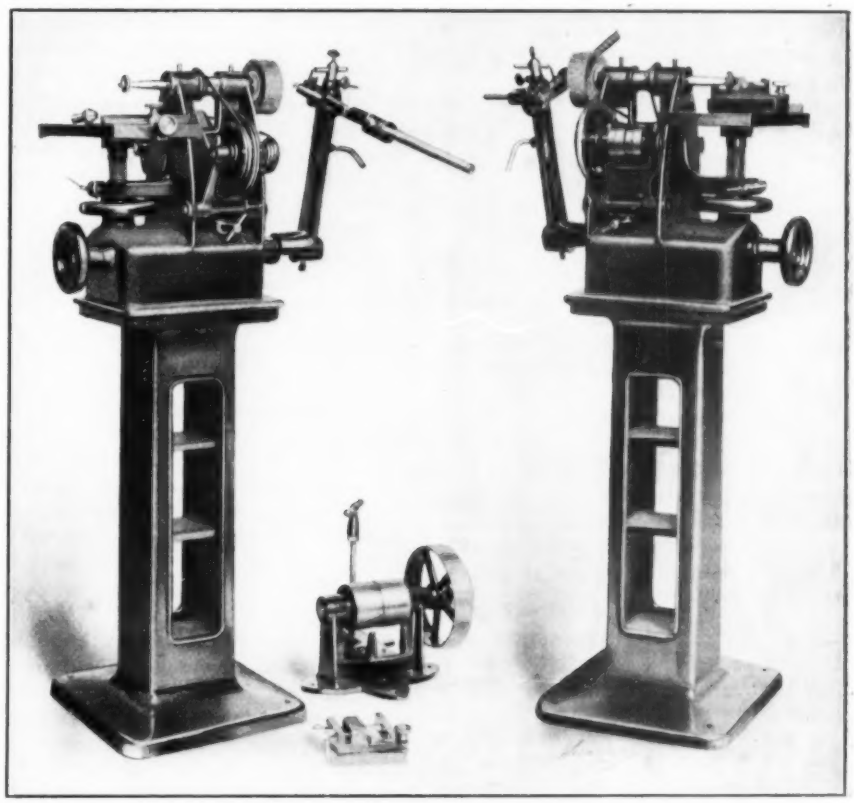
Eight positive feeds are supplied to the plain radials, ranging in geometrical progression from .007 inch to .063 inch inclusive, each instantly and easily obtainable thru two dials on the head, which show the desired feed to be used. Power feed to the spindle is thru a friction, controlled by the handle used for quick advance and return. Four positive feeds are embodied in the full universal radial, obtained by pulling a knob to a notch. The range is from .007 to .045 inches inclusive.

Depth gages and automatic trips are supplied and the spindles are graduated. A safety stop prevents the spindle from feeding beyond the limit. All gears are covered to protect them from contact with overhead cranes.

This machine is built by the American Tool Works Company, Cincinnati, Ohio.

GREENFIELD TAP AND DIE GRINDER.

The grinder shown, front and back, in the half-tone, built by the Greenfield Machine Company, Greenfield, Mass., is adapted for grinding taps, die chasers, chucking reamers, flat surface work, irregular surfaces, and for all kinds of light grinding. The spindle has a 4-inch cup emery wheel on one end and a wheel holder for disk wheels on the other. The latter is easily removable to be replaced by a ⅜-inch spring chcuk for holding emery sticks, etc. The machine has eight different speeds for different sizes of wheels and means are provided for adjusting the

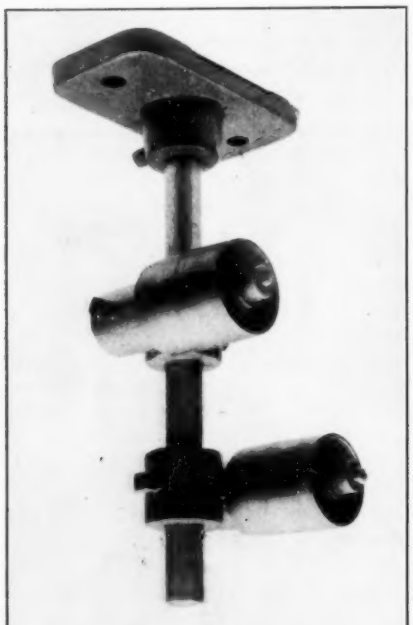


GREENFIELD TAP AND DIE GRINDER.

tension of the belts. The table is raised or lowered by screw and hand-wheel and can be clamped in position. The drive may be direct from a line shaft to tight and loose pulleys on the machine or a countershaft can be furnished. The machine is provided with a special die-chaser holder by means of which an entire set of chasers may be ground alike in relation to the thread. This holder is mounted on a swivel base, so that the chaser may be ground at any required angle. It will grind chasers up to 2¾ inches wide and of any length. There is also a tap sharpening attachment which consists of two center heads mounted on a swinging arm which carries the tap across the face of the cup wheel. The tap can be ground at any angle. Taps without centers or with broken ends can be held correctly. Chucking reamers also can be ground on this machine. Hand taps from ⅜ inch and machine taps up to 1½ inches can be ground. The machine as shown weighs 215 pounds. Without the base it weighs 119 pounds.

AN IDLER STAND.

The illustration shows an idler stand which appears to possess novel features. It is designed for taking a belt from the line-shaft to a machine having a clutch



AN IDLER STAND.

pulley, such as power cutting-off saws, etc., where it is not convenient to place such machine close to the line-shaft. It takes the place of a counter-shaft, being placed above the machine, the belt running from the under side of the line-shaft pulley over the lower idler down to the machine pulley, then up over the upper idler and back to the line-shaft. It can also be used as an ordinary idler-stand to support a long horizontal belt. It will be noted that on this stand the pulleys are placed one on each side of the post, thus facilitating its use in place of a counter-shaft. By using long studs and an extra pulley on each of them, the belt can be carried to a machine having tight and loose pulleys, and may be shifted when necessary. This device is called the "belt transmitter," and is manufactured in two sizes by E. J. Bowers, 3029 Chestnut street, Philadelphia, Pa.

The New Bureau of Manufactures.

J. Hampton Moore, chief of the Bureau of Manufactures of the Department of Commerce and Labor, calls attention in *The American Exporter* to the scope and importance of his bureau. It, very strangely, was not provided for in the act which established the department, but was created by the act of February 14, 1903, the text of which is as follows:

"There shall be in the Department of Commerce and Labor a Bureau to be called the Bureau of Manufactures, and a chief of said Bureau, who shall be appointed by the President, and who shall receive a salary of $4,000 per annum. There shall also be in said Bureau such clerical assistants as may from time to time be authorized by Congress. It shall be the province and duty of said Bureau, under the direction of the Secretary, to foster, promote and develop the various manufacturing industries of the United States, and markets for the same at home and abroad, domestic and foreign, by gathering, compiling, publishing and supplying all available and useful information concerning such industries and such markets, and by such other methods and means as may be prescribed by the Secretary or provided by law. And all consular officers of the United States, including consuls-general, consuls, and commercial agents, are hereby required, and it is made a part of their duty, under the direction of the Secretary of State, to gather and compile, from time to time, useful and material information and statistics in respect to the subjects enumerated in section three of this act in the countries and places to which such consular officers are accredited, and to send, under the direction of the Secretary of State, as often as required by the Secretary of Commerce and Labor, reports of the information and statistics thus gathered and compiled, such reports to be transmitted through the State Department to the Secretary of the Department of Commerce and Labor."

The census of 1900, two years before the Department of Commerce and Labor came into existence, fixes the year's valuation of manufactured products of the United States at more than $13,000,000,000—that is, *three times as much as the products of agriculture*. The various departments—State, Treasury, Army, Navy, Justice, Post-Office, Interior and, more recently, Agriculture—had all been objects of governmental encouragement for years. Commerce and manufactures, up to a little more than two years ago, had never been represented at the nation's council table. So extraordinary had been our commercial and industrial development that this statement, of itself, is remarkable. The great producing power of the country, the inspiration of a nation's material progress, which, with agriculture, constituted the basis of all national wealth, was the last to be chosen for that oversight and encouragement embodied in the law's recognition of a representative at the "seat of government." This recognition, anxiously recommended for agriculture by President Lincoln, but not accorded fully until February 9, 1889, was actually withheld from the greatest of American producers, the manufacturing industrialists, until the nation had startled the world with its genius for domestic achievement and had demonstrated its right to rank with the first of the powers of the world.

Agriculture has been developed and improved, and the standard of living has been raised wherever the influence of its fostering department has penetrated. Its seventeen years of well-directed activity have become an essential part of American progressive history, gratifying alike to the industrious workers on the farm and in the mill. Hence, it is all the more surprising that the onward march of creative industry should not have been officially accepted in its full significance until all the great nations had been compelled to take notice of the wonderful progress of American manufactures, and prepare for the inevitable competition for the world's markets.

In creating the Department of Commerce and Labor, Congress provided for a centralization of effort on the part of the Statistical and Commercial Bureaus of the United States government. The department has been in operation a little more than two years and is now beginning to take up the serious work of developing United States commerce abroad. While the nation exports more than it imports, there is every reason to believe that a much greater volume of business can be transacted with foreign countries if only proper agencies are employed. Individual effort has been and is largely at work in the various nations of the world, and to it much of the success of the friendly commercial relations already established is to be attributed.

So far as the new Bureau of Manufactures of the Department of Commerce and Labor is concerned, it can be said that every possible effort to improve upon existing conditions will be put forth. All the great nations, with pardonable interest in the welfare of their own people, are doing the best they can to attract the attention of buyers for their manufactures. The manufacturers of the United States have been enjoying wonderful progress at home and have not perhaps given as much attention to the development of foreign

markets as the quality and worth of their products would justify.

It is tolerably well known what the other nations are accomplishing in commercial endeavor beyond their own boundary lines, and there is ample machinery under government control, if properly directed, to improve upon the information now in hand. How to direct the forward trade movement will be the principal problem confronting the Department of Commerce and Labor. That the manufacturers and merchants of the United States approve of some movement is plainly shown by the fact that it was they who insisted upon the creation of the department. Though it will take time to bring the governmental agencies into full play for the common benefit, it may be safely asserted that the practical work is about to begin and that it will be prosecuted with all the energy characteristic of American business men.

The issue of the *Daily Consular Reports* for May 12, issued by the Department of Commerce and Labor, Washington, is devoted to the subject of "Municipal Ownership," and the various United States consuls stationed in European cities give, in this number, the result of their investigations of the subject in the respective cities in which they are located. The entire presentation makes a very interesting publication upon the subject, and one which affords the opportunity of acquiring a good deal of useful information about it. The subject is a live one here, and seems to be becoming more so every day.

Personal.

At the recent annual meeting in London of the Iron and Steel Institute a Carnegie Research Scholarship of $500 was awarded to Henry Cook Boynton, instructor in metallurgy and metallography in Harvard University, the third American who has received the award, the two previous awards having gone to men of Columbia University.

W. F. Waldschmidt and Ernst Bechstein, respectively director and chief engineer of the firm of Ludwig Loewe & Company, of Berlin, are visiting America, having come over primarily to attend the Railway Congress at Washington, and while here will look around a little, particularly with a view to buying whatever there may be that is new in the way of machine tools and possibly arranging for the handling of such tools in Germany. They inform us that it is the intention of Ludwig Loewe & Company to confine their work to a few specialties, as is usually done here in America, but they wish to handle other machines not made by their firm, in order to be able to present a complete line to customers.

Obituary.

Albert H. Vogt, only son of Henry Vogt of the Henry Vogt Machine Company, Louisville, Ky., died May 11, twenty-one years old. He was a large stockholder and a director of the company.

John Burke, a machinist, employed in the Pennsylvania R.R. shops at Olean, N. Y., was fatally injured May 13, by a plug blown from an air compressor. Struck near the left eye, his skull was fractured.

Business Items.

The Japanese Government has placed an order for 30 tons of the "A. W." brand of high-speed steel with the English firm of Sir W. G. Armstrong, Whitworth & Co., Ltd. This firm has also contracted to supply the English Admiralty with its tool steel for the next three years.

J. R. Bennett, Henry Hessler and M. E. Becker have purchased the plant of the Poorman Manufacturing Company, of Piqua, Ohio, and have organized as the Piqua Foundry & Machine Company. They will continue the manufacture of sheet metal working machinery and also do general foundry and machine work.

The Vandyck Churchill Company, New York, has recently secured several orders for Colburn boring mills, including a 34-inch, 44-inch and 60-inch from the Otis Elevator Company, of Yonkers; a 53-inch mill from the New York Edison Company; a 34-inch mill from Pratt Institute, Brooklyn, and a 44-inch mill from the Atlantic Coast Line.

A party of prominent engineers and contractors, identified with tunneling enterprises, visited the Glendon, Pa., quarries of the Ingersoll-Sergeant Drill Company recently and saw in operation a new method of tunnel driving with channelers. It was of special interest on account of its availability for tunneling under the foundations of buildings, no heavy blasting being required. The guests left New York on a special train over the Jersey Central Railroad. After the visit to the quarry, they were taken to the new manufacturing plant of the Ingersoll-Sergeant Drill Company at Phillipsburg, N. J., where luncheon was served. The afternoon was devoted to an inspection of the new works. The return was then made by special train.

Manufacturers.

H. H. Wood will erect a new hosiery mill in Lakeport, N. H.

The Buffalo (N. Y.) Candy Company will erect a large factory.

The El Paso (Texas) Vehicle Company is erecting a new factory.

The Leominster (Mass.) Comb Company will erect a new factory.

Grimes & Harris, Leominster, Mass., will build a new machine shop.

The Vulcan Foundry Company, Hamilton, O., will erect a new foundry.

The Kuhlman Car Company will enlarge its plant in Collinwood, Ohio.

The Plant City (Fla.) Brick Company has been formed; capital, $30,000.

The Chicago (Ill.) File & Rasp Company is to erect a new $35,000 factory.

The American Malting Company, Buffalo, N. Y., will erect a large plant.

The Dierdorf Piano Company, Indianapolis, Ind., will erect a new factory.

The Ohio Pattern Works, Cincinnati, O., will erect a plant, to cost $10,000.

The Urie Machine & Boiler Works, Kansas City, Mo., will erect a new plant.

The Waterbury (Conn.) Brass Company will build an addition to its rod mill.

The plant of the Winslow Glass Company, Columbus, O., was burned; loss, $15,000.

The town of Moorhead, Minn., will spend $20,000 enlarging its electric-light plant.

A boiler- and dye-house is to be erected for Chas. Porter & Sons, Philadelphia, Pa.

H. C. Frick Coke Company will build new machine shops at its Connellsville, Pa., plant.

The Challenge Cutlery Company, Bridgeport, Conn., will double the capacity of its plant.

The Chandler Company, Ayer, Mass., machine manufacturers, will put up a new plant.

The Glens Falls (N. Y.) Portland Cement Company will increase the capacity of its plant.

The Champlain Felt Mills, Whitehall, N. Y., will erect an addition to its palnt, to cost $40,000.

A new boiler- and dye-house will be erected for the Berkshire & Becket Silk Company at Becket, Mass.

The Royal Weaving Company, of Pawtucket, R. I., is erecting a large new mill at Darlington, R. I.

The Hendey Machine Company, Torrington, Conn., will erect a new machine shop, to cost $50,000.

The Illinois Steel Company, Chicago, Ill., will erect a million-dollar power plant at its Joliet, Ill., plant.

The Merchants' Dye Works plant, East Dedham, Mass., was damaged by fire to an extent of $10,000.

W. K. Prudden & Co., Lansing, Mich., will erect a new factory for the manufacture of automobile wheels.

F. G. Smith, Leominster, Mass., piano manufacturer, will extend his business and erect another factory.

The plant of the Omaha (Neb.) Casket Company, recently destroyed by a wind storm, will be rebuilt.

The Gem Hammock & Fly Net Company, Milwaukee, Wis., is having plans made for a new factory building.

The Gray & Dudley Hardware Company, Nashville, Tenn., will erect a new foundry and manufacturing plant.

Meurer Bros., Brooklyn, N. Y., will erect a plant in Long Island City for the manufacture of iron and steel plate.

J. J. Fuqua, of Milan, Tenn., has purchased land in Jackson, on which he will erect a $20,000 stave factory.

A. D. Smith & Sons, Fairfield, Me., will erect a canning factory for the Crosby Lumber Company in North Fairfield.

Boehme & Cordella, architects, Minneapolis, Minn., are preparing plans for a building for the Glueck Brewing Company.

The New York Edison Company is erecting another lighting plant, which, if is said, will cost $7,000,000 when completed.

Jas. S. MacLean, Columbus, Ohio, will erect a new plant for the manufacture of office fixtures and builders' mill work.

The shops of the Southern Indiana Railway at Bedford, Ind., will be extensively improved. A new foundry will be built.

The Bonnard-Henry Bronze Company, New York, proposes to move to Mount Vernon, N. Y., where a large plant will be erected.

The agricultural implement factory of P. K. Dederick's Sons, Albany, N. Y., was nearly destroyed by fire; loss, about $20,000.

W. D. Hofius & Co., of Seattle, Wash., manufacturing supplies for railroads, etc., will establish a branch factory in Portland, Ore.

E. A. Bazzett, South Bend, Ind., is at the head of a company organized with a capital of $125,000 to manufacture clocks in Tulsa, I. T.

The Keyser Manufacturing Company, Chattanooga, Tenn., making refrigerators, recently reorganized, will remodel and overhaul its factory, installing an electric power plant.

The Perkins Hosiery Mills have been incorporated at Columbus, Ga., and will erect a mill, for which J. E. Sirrine, of Greenville, S. C., engineer in charge, furnished plans.

The Pennsylvania Railroad is having plans drawn for additional shops at Trenton, N. J., which will include a casting shop, machine shop, lye-house, flue-cleaning shop, boiler and tank-house.

The International Paper Company, New York, is planning to build a power plant and pulp mill at Livermore Falls, Me. The company will also erect a sulphite mill at Chisholm, Me.

The Minnesota Mining & Manufacturing Company, Two Harbors, Minn., making emery wheels, sand paper, etc., has secured a mill in Duluth, Minn., which will be remodeled and new machinery installed at a cost of $150,000.

Geo. E. Clay, real estate dealer, of Long Island City, N. Y., has bought some land in that place for two concerns, on which will be erected large factories, one for electrotyping and color printing, to employ 500 hands; the other for manufacturing glass.

The Elmira Electro-Chemical Company, with a capital of $20,000, has been incorporated to exploit a chemical process for use in bleaching industries, discovered by C. F. Carrier, Jr., of Elmira. A plant will probably be erected in Niagara Falls.

It is reported that, according to a statement given out by T. W. Rowe, of Toledo, O., president of the American Flint Glassworkers' Union, the national organization will erect three lamp-chimney factories in Marion, Ind.; West Virginia and Pennsylvania.

The Standard Paper Spool & Tube Company and the Binns-Fourdrinier Cylinder Company, with the same officers and each with a capital of $150,000, have been organized in New London, Conn., the former company to make machinery for the manufacture of spools and also paper products; the latter to manufacture pulp and paper. A. S. Winchester, of New London, is president.

New Catalogs.

American Air Compressor Works, 26 Cortlandt street, New York. Bulletin illustrating and describing new types of air compressors. 6x9, pp. 16, paper.

International Nickel Company, 43 Exchange Place, New York. Pamphlet containing a list of purposes for which nickel steels have been successfully applied. 3½x6, pp. 16, paper.

East End Boiler Works, 11-19 St. Aubin avenue, Detroit, Mich. Catalog describing "Detroit" water-tube and Scotch water-tube boilers for stationary and marine use. Illustrated. 6x7½, pp. 32, paper.

The Manvile Bros. Company, Waterbury, Conn. Supplement to Catalog "A," giving dimensions of two new automatic wire and metal forming machines, also circular describing the Yankee bench press.

Pawling & Harnischfeger, Milwaukee, Wis. 1905 catalog of cranes. This is a handsome catalog containing excellent half-tone illustrations, line drawings, list of standard sizes and a list of users. 9x12 pp. 139, paper.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 54, "A Few Words About Electric Fans." Illustrated. 5x8, pp. 8, paper. Bulletin No. 52 (superseding No. 26) on railway generators. Illustrated. 7½x10, pp. 11, paper.

Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York. Form 340, "The Blue Book of Air Compressors." This is a well-printed little book describing briefly the standard classes of air compressors and other products made by this company. Half-tone illustrations. 5x7, pp. 31, paper.

The Ingersoll-Sergeant Drill Company (pneumatic tool department), 26 Cortlandt street, New York. Bulletin No. 2002, "Track Laying on the Williamsburg Bridge." This gives some facts concerning the costs and materials used for the Williamsburg Bridge and also a description of track work. Illustrated. 6x9, pp. 16, paper.

The Bristol Company, Waterbury, Conn. Catalog No. 28 of recording thermometers. In this catalog the thermometers have been classified into three different classes, according to the principles upon which they depend for their operation, thus making it convenient for a prospective user to select one suited to his needs. Illustrated. 9x12, pp. 47, paper.

Yale & Towne Manufacturing Company, 9-15 Murray street, New York, has sent us copies of two little booklets which it is distributing at the Interntaional Railway Convention in Washington, one entitled "Locks and Hardware for Railroad Use," and the other, "Yale & Towne Chain Blocks and Electric Hoists." These are illustrated, printed on good coated paper, the last mentioned booklet containing a map of New York.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

H. Maddox wants hydraulic wheel press. Address Archer, Fla.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Machinist Table—Standard steam, gas and water pipe tapping sizes; 5c., stamps. E. E. Meyer, Allegheny, Pa.

Automatic machines, construction and designs; undertake manufacturing; experimental. 568 West Broadway, New York.

Would like to build some standard specialty on orders; low prices; prompt delivery. W. S. Machine Company, care AMER. MACH.

Wanted—Grinder for horizontal surfaces, 6x24 in.; must be in good condition and a bargain. Box L, Station B, Cincinnati, Ohio.

Dies, jigs and fixtures; tools designed for special work; manufacturer of clockwork specialties and intricate mechanical instruments. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—Canadian right to build machine of established reputation; plant and equipment the very best for 500 men. Address "Business," Box 99, AMERICAN MACHINIST.

Close prices and close work on automatic and other machinery; write for estimate; will consider purchase machine or tool likely to prove a seller. Box 169, AMER. MACH.

W. H. Chappell, the best machine shop organizer, manager, critic and cost-cutter in America, solicits correspondence regarding temporary engagements. Box 57, AM. M.

Machine factory in Germany, fitted with the newest and best American machinery tools, which is chiefly building fine special machines, wishes to take up the manufacturing of some good-paying machinery or of articles of fine machine building or of fine mechanics. Please apply to F. N. W., 630, care Rudolf Mosse, Frankfurt a. M., Germany.

For Sale.

For Sale—Controlling interest in established supply and machine business; good paying proposition. Box 164, AMER. MACH.

For Sale.—$2,500 will buy interest in an established foundry; a good opportunity for an experienced man. Box 151, AMER. MACH.

For Sale—U. S. patent rights for small machine of established reputation; demand great enough to keep large factory now running night and day. For particulars apply to Box 98, AMERICAN MACHINIST.

Business Opportunities.

Young man with mechanical, technical and business training desires to place his services and small capital in some established business. Box 172, AMERICAN MACHINIST.

Satisfaction Guaranteed.—We build special machinery, machine parts, interchangeable machinery, punches and dies; gear cutting, etc. The John R. Williams Co. Machine Works, 114-116 Liberty St., New York; 120-126 Pacific St., Newark, N. J.

A foundry connected with a manufacturing plant can produce more castings than they require. An enterprising foundryman to take charge of this branch and invest from $5,000 to $10,000, can make profitable terms. Box 155, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Designer, with 7 years of experience on high-grade automobiles, wishes to make a change; technical graduate. Box 157, AM. M.

ENGLAND.

Two young draftsmen (English) desire situation anywhere in Canada; well up in pressure and suction gas plant design, pneumatic and general; sound technical training. Box 135, AMERICAN MACHINIST.

ILLINOIS.

Die and tool maker; age 37; experience 18 years; broad practice, interchangeable parts, etc.; at present toolroom foreman of 14 men; West or Middle West. "Chi.," care AM. M.

MICHIGAN.

Designing draftsman with extensive experience and familiar wtih modern manufacturing requirements. Address "Manufacturing," care AMERICAN MACHINIST.

NEW JERSEY.

Mechanical engineer, university graduate, wishes change; broad experience in designing gas engines, suction and pressure gas producers and complete power plants. Box 173, AMERICAN MACHINIST.

Mechanical engineer and draftsman wants position; 15 years of experience in steel construction and machines of various kinds; careful working drawings a specialty. Box 166, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 165, care AMERICAN MACHINIST.

Expert on erecting machine tools desires change; age 29; excellent past record. Box 159, AMERICAN MACHINIST.

Mechanical draftsman, age 24, wishes position; $18 weekly; tools and general machinery. Box 176, AMERICAN MACHINIST.

A designer of special and automatic machinery wishes to change; 6 years with present employers. Address Box 156, AM. MACH.

Draftsman; experience general, special, machinery, engineering work; New York-New Jersey preferred. Box 174, AM. MACH.

Position as superintendent or assistant; mechanical and technical training; familiar with shop organization and methods. Box 171, AMERICAN MACHINIST.

Mechanical engineer, experienced designer of cranes and hoisting machinery, industrial railway equipment, hydraulic machinery and other standard and special lines, wishes responsible position. Box 168, AMER. MACH.

Mechanical engineer, gas engine expert, extensive experience in designing, testing and building of internal combustion engines, able to introduce gas engine building, wants position as chief engineer or superintendent, eventual representative. Box 124, AMER. MACH.

Mechanical engineer; skilled in modern works management; experienced designer

steam engines, turbines, direct-acting and turbine pumps, cranes and general machinery; 14 years' U. S. Government experience on hulls, ship machinery and construction plant. Address M. E., care R. G. Peters, 302 Spring st., New York City.

OHIO.

Superintendent of tool works seeks wider field of operation and solicits correspondence with parties in or near New York city. Address Box 108, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Superintendent of engine and general machine shop desires position; traveling salesman, superintendent or foreman; wide practical experience; designer of tools, jigs and special machinery. Address Box 122, A. M.

Mechanical engineer, expert designer of gas, oil engines and gasoline traction engines, thoroughly familiar with shop practice, now employed in such work, desires change end of May or early June. Address G. Branning, San Leandro, Cal.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

A man well versed in all kinds of machinery; machine building, especially automatic tools. Box 160, AMERICAN MACHINIST.

Wanted—Good all-around machinists on engine and general machine work; good pay and steady work. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

A firm located near New York city, engaged in manufacturing small gasoline engines, located near New York city, would like to correspond with successful shop foremen who are anxious to better themselves. Address Box 162, AMERICAN MACHINIST.

GEORGIA.

Wanted—Superintendent with technical education, for job and contracting shop; must be able to get out work promptly and at reasonable cost. "Machine Shop," care AMERICAN MACHINIST.

ILLINOIS.

Wanted—By concern building heavy machine tools, several good fitters; good wages; steady employment to the right men. Box 175, AMERICAN MACHINIST.

Patternmakers.—A large manufacturing company has vacancies for several patternmakers; must be familiar with engine work and general heavy machinery patterns. Address, with full particulars, Box 34, AM. M.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

LOUISIANA.

Wanted—A thoroughly capable chief draftsman, experienced in link-belting conveying devices and rope drives; salary $200 per month. Address Machinery Department, Post Office Box 1296, New Orleans, La.

MASSACHUSETTS.

Wanted—Machinists, experienced operators on planers, milling machines and Jones & Lamson turrets. Box 152, AMER. MACH.

MICHIGAN.

Wanted—Thoroughly competent toolmaker as foreman of tool department in large brass factory, manufacturing valves, engine trimmings, etc.; only first-class man wanted; state experience and salary desired. Box 136, A. M.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern and up-to-date methods. To honest, competent men who will "do things' steady work and first-class wages are waiting. State experience, age, references and full information. Cadillac Automobile Company, Detroit, Mich.

NEW HAMPSHIRE.

Blacksmith foreman; must be experienced in engine and machinery forging, tempering and light hammer work; modern shop, employing 15 men; give references and pay expected. Box 170, AMERICAN MACHINIST.

NEW JERSEY.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

First-class tool and die maker wanted for fine, accurate work; wages $21 to start. Address 37 W. 116th st., New York City.

Wanted—Foreman for sheet metal shop; one having had experience in fan building desired; write, stating age, references, etc. Address Box 154, AMERICAN MACHINIST.

Wanted—Three good draftsmen with mechanical knowledge to design pumps and hydraulic machinery; technical graduates preferred. Box 106, AMERICAN MACHINIST.

Wanted—Several good detail draftsmen and tracers on light construction work, by a large concern in New York city; personal interview necessary; state age, experience and salary expected. Box 158, AMER. MACH.

Draftsman Wanted.—Good, steady position and liberal compensation with chance of advancement to chief, for one accustomed to sugar-cane crushing machinery; others need not apply; answer in absolute confidence, stating present employment. Box 167, A. M.

Wanted—An energetic young man having ability to handle and instruct apprentice boys on a battery of engine lathes; a good opportunity is open; advancement according to ability. Address, stating wages and references, Imperial Engine Co., Painted Post, N. Y.

Assistant foreman for punch press department of a large firm turning out light, interchangeable work; must be accustomed to compound dies, sub-press work and presses with automatic feeds; location, central New York; state nationality, age and experience. Address Box 163, AMERICAN MACHINIST.

Wanted.—We need the services of several designing draftsmen of large experience and undoubted ability and resourcefulness; our work is special machinery and sheet metal tools; applications will be considered only of those who can fully satisfy us as to their qualifications, and whose record will bear the closest investigation; the salary will be liberal. Address, with all particulars, "Thorough," care AMERICAN MACHINIST.

OHIO.

First-class automatic screw machine hand; must thoroughly understand the Cleveland and Acme automatic screw machines. Address P. O. Box 876, Cincinnati, Ohio.

Wanted—First-class man as foreman for brass shop located in a large Western city; we want strictly first-class, up-to-date man; one who is familiar with various makes of molding machines, also a good judge of human nature, and one that can control and handle men; kindly state age and experience. Box 153, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Foreman; an expert on sheet metal tools and dies; a person of executive ability required. Box 161, AMER. MACH.

Wanted—Lathe, planer, boring mill and milling machine operators, floor and bench fitters, also a few good wood pattern makers. Address or call, Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—Machinist to assemble engines by contract, also one to do machine work, or one man to do both; only men with experience need apply; chance for hustling man who knows how to do high-class work to make big money. Box 100, AMERICAN MACHINIST.

TEXAS.

Wanted—Superintendent for our machine shop, working about 30 men now, but expect to enlarge shortly; our work is general repairs on sawmill, cotton oil mill and sugar machinery engines, locomotives, marine engines and pumps; we also build new rotary pumps and other machines on orders; have no special machine line that we manufacture; our general foundry is well equipped and under capable management; must be competent to make estimates on all work, a handler of men—in fact, a first-class man. Address, with full particulars as to former work, salary, etc., Dickson Car Wheel Co., Houston, Texas.

WEST OF MISSISSIPPI.

Wanted—A strictly first-class machinist as foreman of a small machine shop; must be capable of handling the entire business connected with the shop; a good position for the right man. Address "Iowa," care AM. MACH.

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Norton Emery Wheel Co., Worcester, Mass.
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Ingersoll-Sergeant Drill Co., New York.

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Belt Lacing Machine

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Betts Mach. Co., Wilmington, Del.
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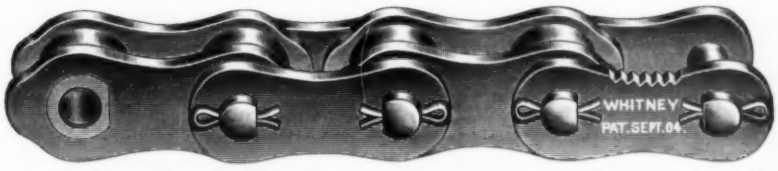
"Whitney" Hand (Feed) Milling Machine

used in preference to all others by U. S. Government, Western Electric Co., Underwood Typewriter Co., Smith & Wesson, Hopkins & Allen Arms Co., Standard Adding Machine Co., Smith Typewriter Co., leading Automobile Manufacturers, etc., etc.? Possibly it is because we make more of a specialty of Hand Millers than any other company in the world, and give our customers greater return for their investment by way of quality, quantity, range and efficiency.

PITCH	DIAMETER OF ROLL
1 in.	$\frac{5}{8}$ in.
$1\frac{1}{4}$ in.	$\frac{3}{4}$ in.
$1\frac{1}{2}$ in.	$\frac{7}{8}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.



These Are **"WHITNEY" STANDARDS** For ROLLER CHAINS

The Pitch Sizes and Diameters

advance uniformly in perfect proportion. They have Broken all Records for Efficiency, and have been adopted for most of the leading American Cars, including

"Acme" "Auto-Car Equipment" "Baker" "Bramwell" "Cadillac" "Columbia" "Corbin" "Champion" "Elwell-Parker" "Ford" "Franklin" "Grout" "Gaeth" "Gibbs" "Hartford Motor Street Sweeper" "Knox" "Lenawee" "Mitchell" "Moline" "Matheson" "Milwaukee Four-Wheel Drive" "Manhattan" "Olds" "Pope-Hartford" "Pierce-Racine" "Prescott" "Queen" "Rambler" "Stearns" "Sommer" "Snell" "Thomas 50 and 60 H.P." "Tourist" "Wayne" "Western-Electric."

PITCH	DIAMETER OF ROLL
1 in.	$\frac{9}{16}$ in.
$1\frac{1}{4}$ in.	$\frac{5}{8}$ in.
$1\frac{1}{2}$ in.	$\frac{3}{4}$ in.
$1\frac{3}{4}$ in.	1 in.
2 in.	$1\frac{1}{8}$ in.

These are the Old or Competing Standards

The **PITCH SIZES** advance uniformly, but the **DIAMETERS** are irregular and not in perfect proportion.

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Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

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Electric Controller & Supply Co., Cleveland, O.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.

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Boston Gear Works, Boston, Mass.

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See Grinding Wheels.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

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Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
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Pratt & Whitney Co., Hartford, Conn.

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Windsor Mach. Co., Windsor, Vt.

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Brown & Co., R. H., New Haven, Conn.
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Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.

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Whitney Mfg. Co., Hartford, Ct.
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Gisholt Mach .Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
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Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

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Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
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Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

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Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

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Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
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American Elec. & Controller Co., New York.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Niles-Bement-Pond Co., New York.

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Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Electric Controller & Supply Co., Cleveland, O.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Cranes
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Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mch. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Osgood, J. L., Brooklyn, N. Y.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Perkins Mach. Co., Warren, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

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Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

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Taylor Mfg. Co., Jas. L., Bloomfield, N. J.

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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
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Aurora Tool Works Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn
Vanderbeek Tool Works, Hartford, Conn.

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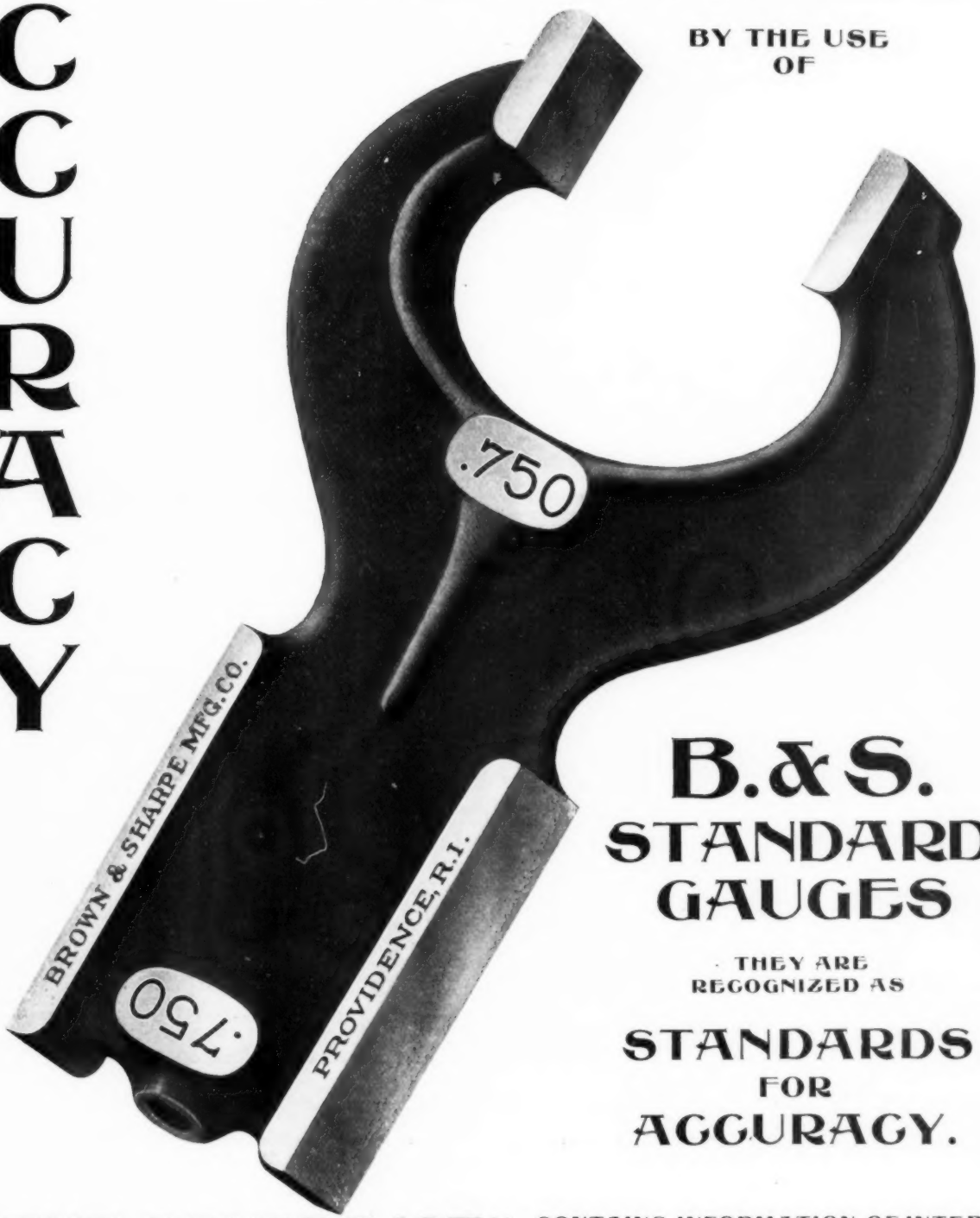

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Aurora Tool Works, Aurora, Ind.
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Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. F., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
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Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Valentine Gas Engine Co., Plainfield, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., The, Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.

Dynamos—*Continued*
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
American Elec. & Controller Co., New York.
Clark & Co., Jas., Jr., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark & Co., Jas., Jr., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Filters, Oil
Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Erie Forge Co., Erie, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.

Gear Cutting Machinery
Continued
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrell Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

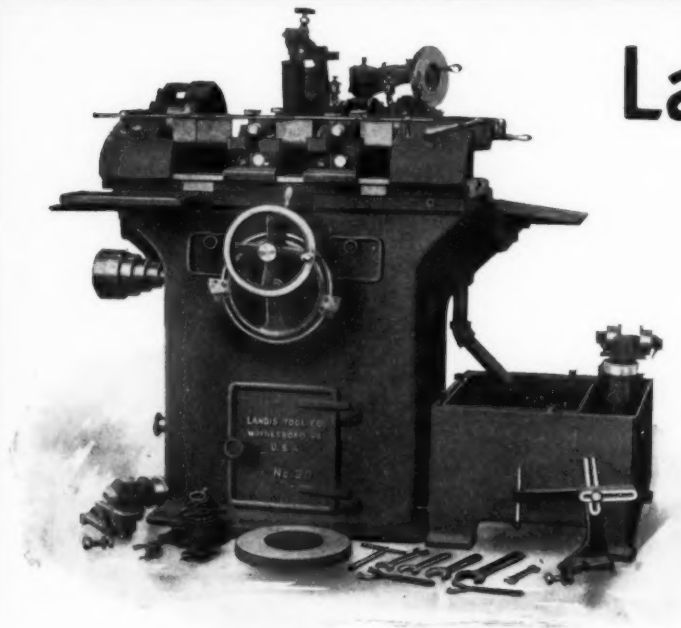
Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.



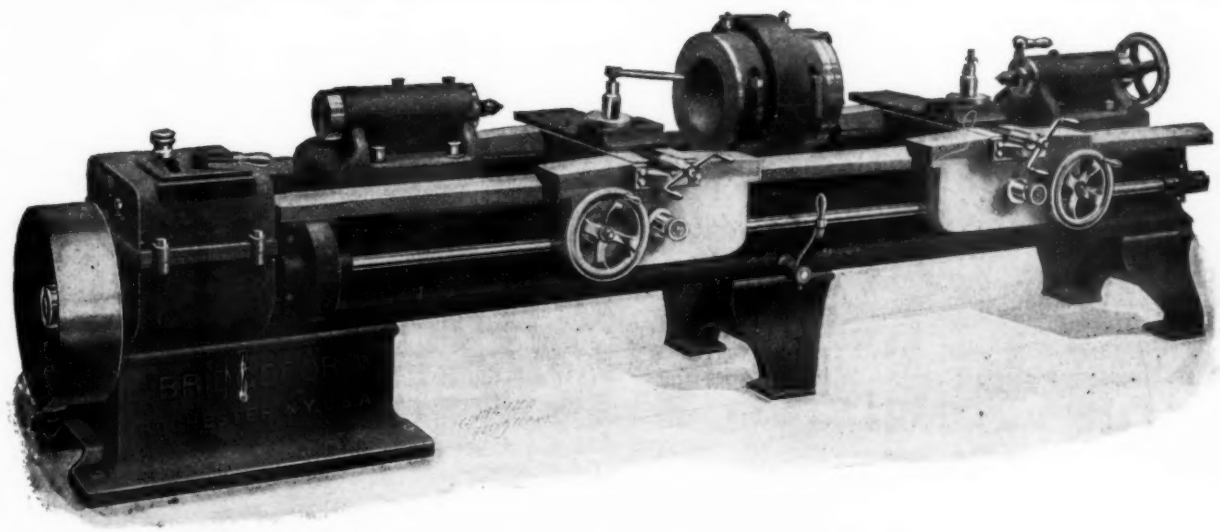
Landis Grinders

No matter what you grind there is a Landis Grinding Machine that exactly suits your requirements. They are built in many sizes and styles, each style possessing those features which go to make the Landis superior to any grinding machine in use. Some are particularly adapted for manufacturing purposes, for finishing great quantities of similar parts. Some are especially for internal grinding. Others are best for grinding a large variety of parts. Still others are for finishing large tools, and so on. The line covers the entire field, and a Landis Grinder will put your grinding on a high-speed basis and on a higher degree of accuracy. Communicate your grinder needs to us.

No. 20 Plain Grinding Machine.
10-inch swing. 20 inches between centers.

Landis Tool Company, Waynesboro, Pa., U.S.A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.



High Speed Axle Finishing.

The "Bridgeford" Double Head Lathe finishes the axle complete at both ends without reversing. Every modern improvement. Constant speed pulley. Cutting speeds obtained by gearing through a speed variator. Heavy steel gears are incased and run in oil. Special bulletin.

Bridgeford Machine Tool Works, Rochester, N. Y., U.S.A.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cncin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Kingston, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.

Grinding Wheels—*Continued*
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Cleveland Stone Co., The, Cleveland, O.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hoist Mfg. & Const. Co., Philadelphia, Pa.
International Steam Pump Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

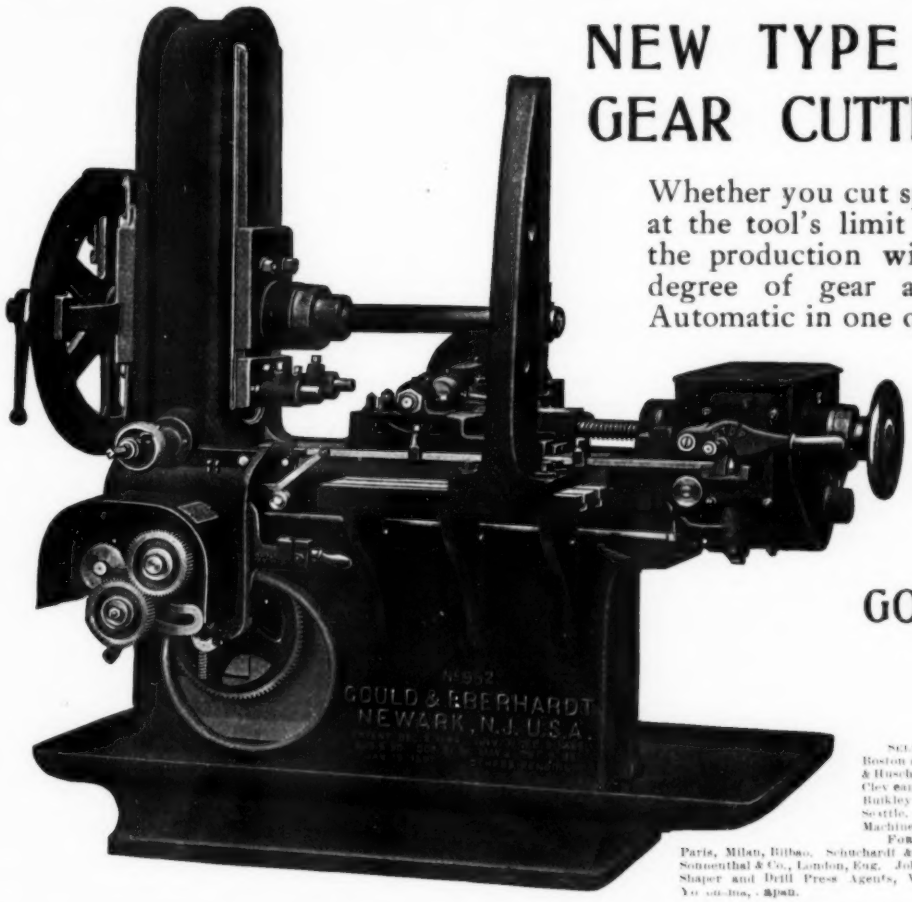
Lathes
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co. J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.



NEW TYPE AUTOMATIC GEAR CUTTING MACHINE.

Whether you cut spur gears in quantities at the tool's limit of speed, or otherwise, the production will test to the highest degree of gear accuracy ever reached. Automatic in one operation.

Automatic Gear Cutting Machines

AND

Accessories, Shapers, Drill Presses.

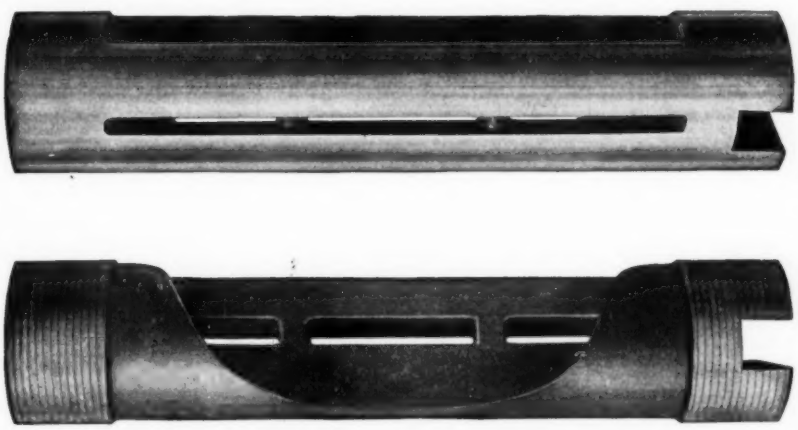
GOULD & EBERHARDT,

NEWARK, N. J., U.S.A.

SELLING AGENTS—Prentiss Tool and Supply Co., New York, Boston and Buffalo. Baird Machinery Co., Pittsburg, Pa. Marshall & Huschart Machinery Co., Chicago. Mitch & Merryweather Macny Co., Cleveland. The Fairbanks Co., Philadelphia and Baltimore. Henshaw, Bulkley & Co., San Francisco. Hallidie-Henshaw-Bulkley Co., Seattle. W. R. Colcord Machinery Co., St. Louis. McArdle-Parker Machinery Co., New Orleans and Birmingham.

FOREIGN AGENTS—Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna Stockholm, St. Petersburg. Selig, Sonnenthal & Co., London, Eng. John Lang & Sons, Johnstone, Scotland. White, Child & Beney, Shaper and Drill Press Agents, Vienna. Adolfo B. Horn, Havana, Cuba. F. W. Horne, Yokohama, Japan.

EXHAUST VALVE.



Size: 26″ long, 5½″ diameter.

Turned from rough casting ONE CUT 4 PITCH, reduction in diameter ¼″, TIME 10½ MINUTES.

Ground from above turning in Norton Plain Grinder, reduction in diameter 1-32″, time 30 minutes.

Total time from ROUGH CASTING to FINISHED GROUND VALVE 42 MINUTES.

THINK THIS OVER.

Can you do as well as this with the machines you have?

REMEMBER this is a nice ground surface, not an irregular surface from a broad nose turning tool or a file. Others are using our Grinding Machines in connection with high speed turning.

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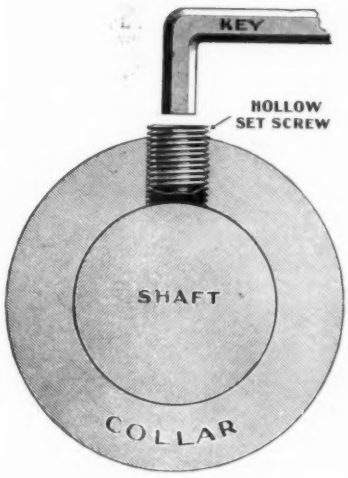
The New Hollow Set Screws Eliminate Danger

U. S. Patent 679,927



THE New Hollow Screws have no projections—you screw them down well within the collar. No shoulders; no countersinking; no protectors and hubs necessary. That means a saving in cost and labor; eliminates all danger of accident.

They are made of steel, drawn with a hexagonal hole, which insures elasticity and prevents loosening during changes of temperature. With the wrench shown in illustration, the screw can be tightened or removed with ease, and there is no worn, battered screw slots or twisting off of heads to contend with. You get a bearing with the wrench the entire length of the screw, and force is applied largely at the point of the screw, where it is required.

WITH the Hollow Set Screws one length of each size is all that is required for any depth of hole, and thus by eliminating sizes they are much cheaper in the aggregate than the old style screws.

Short screws do not lose lead of thread as do long ones. By putting two screws in a hole they are locked and the thread strain is equalized.

Deep holes need be threaded at bottom only.

Hollow Screws can be sealed against rust and wet by filling the hole with wax or oil.

Hollow Set Screws have passed the experimental stage. Several hundreds of firms have tested them and found them advantageous in a great many ways.

Send for Circular No. 1644 and Samples.

MADE IN FOUR DIAMETERS ONLY AS FOLLOWS. U. S. STD. THREAD CUP POINT.

Diameter	Thread	Length	How Packed
⅜-inch	16	⅜-inch	100 in box
½-inch	12 and 13	$\frac{9}{16}$-inch	100 in box
⅝-inch	11	$\frac{11}{16}$-inch	50 in box
¾-inch	10	⅞-inch	50 in box

Hammacher, Schlemmer & Co.

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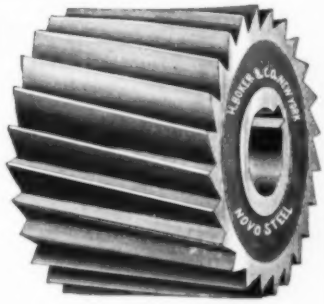
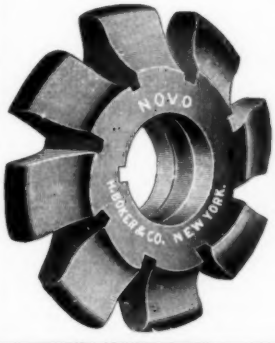
Sole Agents **4th Av. and 13th St., New York**

Novo Milling Cutters Are On Top.

They will run the limit of your machines in speeds and feeds, and you will more than double your output by using them.

Write for our Novo Small Tool Department Catalogue.





We make all styles of **Novo** Milling Cutters and guarantee them and furnish them subject to trial and approval.

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Shafting
Brightman Mfg. Co., Shelby O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Churchill Co., New York.

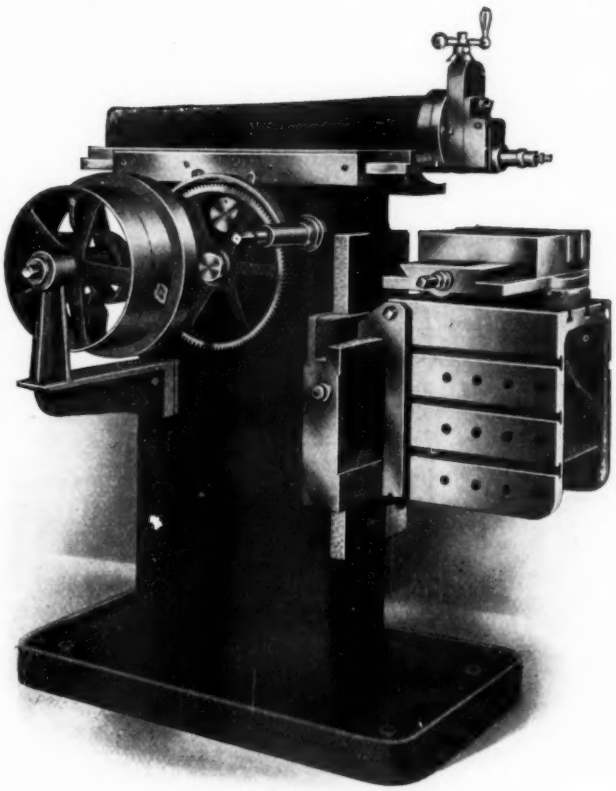
Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., Warren, Mass.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slide Rests
American Watch Tool Co., Waltham, Mass.

Hendey 15″ Tool Room Shaper, Re-Designed and Improved



Has heavier Cross-head Dial reading to Thousandths on Cross-feed Screw.

Taper Gib between Cross-rail and Saddle with Adjustment at Both Ends.

Safety Stop for Ram to prevent extreme return when head is down on an angular cut.

It has All the Good Features that this Shaper has Long Been Noted For, but it is now Just a Little Bit Better Than It Ever Was Before.

The Handiest Tool Room Shaper in the Market to-day.

The Hendey Machine Co.

Torrington, Conn.

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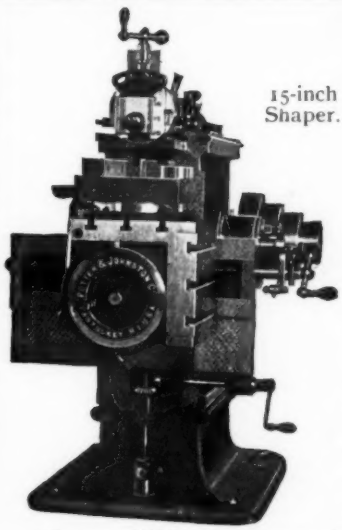

15-inch Shaper.

THE P. & J. SHAPER puts a kink in cost and boosts up quality

"Same old story?" Yes—but we "make good." P. & J. Shapers can't be compared with any other shapers because they're radically different—really better—actual experience and the hardest tests of usage prove this true.

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Ram slide is unusually long—long ram and quick return—may be set to any length of stroke while machine is running.

Send for catalog and special bulletins.

Do it now—it's poor policy to postpone profit.

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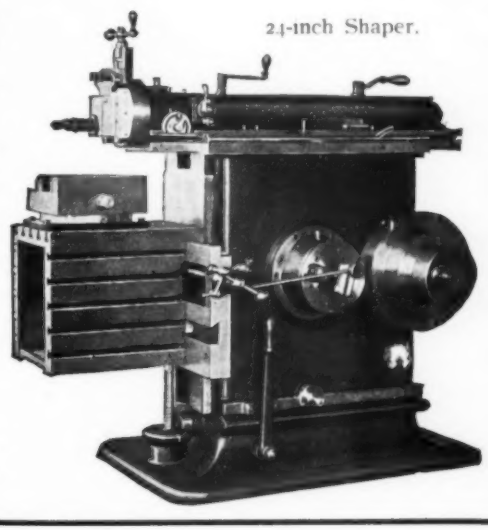

Potter & Johnston Machine Co.,

Pawtucket, R. I., U. S. A.

New York: 126 Liberty St., Walter H. Foster, Mgr. Cleveland Office: 513 Williamson Bldg.

BRANCH OFFICES: Boston, Philadelphia, Pittsburg, Chicago. PARIS OFFICE: 54 Avenue de Neuilly, J. Ryan, Mgr. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle, England, and Glasgow, Scotland. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Milano. H. W. Petrie, Toronto and Montreal, Canada.

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Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
New Haven Mfg. Co.. New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

Special Machines and Tools
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co.. Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mechanics Machine Co., Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O

Stampings, Welded
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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Federal Mfg. Co., Cleveland, O.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Baldwin Steel Co., New York.
Boker & Co.. Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin B., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brightman Mfg. Co., Shelby, O.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electric Controller & Supply Co., Cleveland, O.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland. O.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Tuttle Mfg. Co., H. A., South Norwalk, Conn.
Valentine Gas Engine Co., Plainfield, N. J.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Twist Drill Co.. Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardiner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.

Tool Holders—*Continued*
Hoggson & Pettis Mfg. Co., New Haven, Conn
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford. Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co.. Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Philips Pressed Steel Pulley Wks., Philadelphia, Pa.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Harrington, Son & Co.. Edwin. Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn. N. Y.

Turret Head Attachment
Baker Mach. Co., New Bedford, Mass.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co.. Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence. R. I.
Bullard Mach. Tool Co.. Bridgeport. Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co.. Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co.. Hartford. Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Morse Twist Drill & M. Co., New Bedford. Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co.. New York
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Universal Joints
Baush Mach. Tool Co.. Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Specialties.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Vanderbeek Tool Works, Hartford, Conn.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co.. Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co.. Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon. Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardiner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
C & C Elec. Co., New York.
Standard Welding Co.. Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford. Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co.. Hartford. Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co.. Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.